FUJITSU SEMICONDUCTOR
CONTROLLER MANUAL

CM25-00324-5E

F²MC-8L/8FX FAMILY

SOFTUNE™ Workbench

USER'S MANUAL

FUJITSU

F^{2}MC-8L/8FX FAMILY

SOFTUNE™ Workbench

USER'S MANUAL

FUJITSU SEMICODUCTOR LIMITED

PREFACE

■ What is the SOFTUNE Workbench?

SOFTUNE Workbench is support software for developing programs for the F^2MC-8L/8FX family of microprocessors / microcontrollers.

It is a combination of a development manager, simulator debugger, emulator debugger, monitor debugger, and an integrated development environment for efficient development.

Note: F^2MC stands for FUJITSU Flexible Microcontroller.

■ Purpose of this manual and target readers

This manual explains functions of SOFTUNE Workbench.

This manual is intended for engineers designing several kinds of products using SOFTUNE Workbench.

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■ Organization of Manual

This manual consists of 2 chapters.

CHAPTER 1 BASIC FUNCTIONS

This chapter describes the basic functions on the SOFTUNE Workbench.

CHAPTER 2 DEPENDENCE FUNCTIONS

This chapter describes the functions dependent on F^2MC-8L/8FX family MCU.

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CHAPTER 1

BASIC FUNCTIONS

This chapter describes the basic functions on the SOFTUNE Workbench.

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1.1 Workspace Management Function

This section explains the workspace management function of SOFTUNE Workbench.

■ Workspace

SOFTUNE Workbench uses workspace as a container to manage two or more projects including subprojects.

For example, a project that creates a library and a project that creates a target file using the project can be stored in one workspace.

■ Workspace Management Function

To manage two or more projects, workspace manages the following information:

- Project
- Active project
- Subproject

■ Project

The operation performed in SOFTUNE Workbench is based on the project. The project is a set of files and procedures necessary for creation of a target file. The project file contains all data managed by the project.

■ Active Project

The active project is basic to workspace and undergoes [Make], [Build], [Compile/Assemble], [Start Debug], and [Update Dependence] in the menu. [Make], [Build], [Compile/Assemble], and [Update Dependence] affect the subprojects within the active project.

If workspace contains some project, it always has one active project.

■ Subproject

The subproject is a project on which other projects depend. The target file in the subproject is linked with the parent project of the subproject in creating a target file in the parent project.

This dependence consists of sharing target files output by the subproject, so a subproject is first made and built. If making and building of the subproject is unsuccessful, the parent project of the subproject will not be made and built.

The target file in the subproject is however not linked with the parent project when:

- An absolute format (ABS)-type project is specified as a subproject.
- A library (LIB)-type project is specified as a subproject.

■ Restrictions on Storage of Two or More Projects

Only one REALOS-type project can be stored in one workspace.

1.2 Project Management Function

This section explains the project management function of SOFTUNE Workbench.

■ Project Management Function

The project manages all information necessary for development of a microcontroller system.

- Project configuration
- Active project configuration
- Information on source files, include files, other object files, library files
- Information on tools executed before and after executing language tools (customize build function)

■ Project format

The project file supports two formats: a "workspace project format", and an "old project format".

The differences between the two formats are as follows:

● Workspace project format

- Supports management of two or more project configurations
- Supports use of all macros usable in manager
- Does not support early Workbench versions*

● Old project format

- Supports management of just one project configuration
- Limited number of macros usable in manager
  For details, see Section "1.11 Macro Descriptions Usable in Manager".
- Supports early Workbench versions*

When a new project is made, the workspace project format is used.

When using an existing project, the corresponding project format is used.

If a project made by an early Workbench version* is used, a dialog asking whether to convert the file to the workspace project format is displayed. For details, refer to Section "2.13 Reading SOFTUNE Project Files of Old Versions" of "SOFTUNE Workbench Operation Manual".

To open a project file in the workspace project format with an early Workbench version*, it is necessary to convert the file to the old project format. For saving the file in other project formats, refer to Section "4.2.7 Save As" of "SOFTUNE Workbench Operation Manual".

*: V30L26 or earlier

■ Project Configuration

The project configuration is a series of settings for specifying the characteristics of a target file, and making, building, compiling and assembling is performed in project configurations.

Two or more project configurations can be created in a project. The default project configuration name is Debug. A new project configuration is created on the setting of the selected existing project configuration. In the new project configuration, the same files as those in the original project configuration are always used.

By using the project configuration, the settings of programs of different versions, such as the optimization level of a compiler and MCU setting, can be created within one project.

In the project configuration, the following information is managed:

- Name and directory of target file
- Information on options of language tools to create target file by compiling, assembling and linking source files
- Information on whether to build file or not
- Information on setting of debugger to debug target file

■ Active Project Configuration

The active project configuration at default undergoes [Make], [Build], [Compile/Assemble], [Start Debug], and [Update Dependence].

The setting of the active project configuration is used for the file state displayed in the SRC tab of project window and includes files detected in the Dependencies folder.

Note:

If a macro function newly added is used in old project format, the macro description is expanded at the time of saving in old project format. For the macro description newly added, refer to Section "1.11 Macro Descriptions Usable in Manager".

1.3 Project Dependence

This section explains the project dependence of SOFTUNE Workbench.

■ Project Dependence

If target files output by other projects must be linked, a subproject is defined in the project required in [Project Dependence] in the [Project] menu. The subproject is a project on which other projects depend.

By defining project dependence, a subproject can be made and built to link its target file before making and building the parent project.

The use of project dependence enables simultaneous making and building of two or more projects developed in one workspace.

A project configuration in making and building a subproject in [Project Configuration]-[Build Configuration] in the [Project] menu can be specified.

1.4 Make/Build Function

This section explains the make/build function of SOFTUNE Workbench.

■ Make Function

Make function generates a target file by compiling/assembling only updated source files from all source files registered in a project, and then joining all required object files.

This function allows compiling/assembling only the minimum of required files. The time required for generating a target file can be sharply reduced, especially, when debugging.

For this function to work fully, the dependence between source files and include files should be accurately grasped. To do this, SOFTUNE Workbench has a function for analyzing include dependence. For details, see Section "1.5 Include Dependencies Analysis Function".

■ Build Function

Build function generates a target file by compiling/assembling all source files registered with a project, regardless of whether they have been updated or not, and then by joining all required object files. Using this function causes all files to be compiled/assembled, resulting in the time required for generating the target file longer. Although the correct target file can be generated from the current source files.

The execution of Build function is recommended after completing debugging at the final stage of program development.

Note:

When executing the Make function using a source file restored from backup, the integrity between an object file and a source file may be lost. If this happens, executing the Build function again.

1.4.1 Customize Build Function

This section describes the SOFTUNE Workbench to set the Customize Build function.

■ Customize Build Function

In SOFTUNE Workbench, different tools can be operated automatically before and after executing the Assembler, Compiler, Linker, Librarian, Converter, or Configurator started at Compile, Assemble, Make, or Build.

The following operations can be performed automatically during Make or Build using this function:

- Starting the syntax check before executing the Compiler,
- After executing the Converter, starting the S-format binary Converter (m2bs.exe) and converting Motorola S-format files to binary format files.

■ Setting Options

An option follows the tool name to start a tool from SOFTUNE Workbench. The options include any file name and tool-specific options. SOFTUNE Workbench has the macros indicating that any file name and tool-specific options are specified as options.

If any character string other than parameters is specified, it is passed directly to the tool as it is. For details about the parameters, see Section "1.11 Macro Descriptions Usable in Manager".

■ Macro List

The Setup Customize Build dialog provides a macro list for macro input. The build file, load module file, project file submenus indicate their sub-parameters specified.

The environment variable brackets must have any item; otherwise, resulting in an error.

Table 1.4-1 Macro List

Macro List	Macro Name
Build file	%(FILE)
Load module file	%(LOADMODULEFILE)
Project file	%(PRJFILE)
Workspace file	%(WSPFILE)
Project directory	%(PRJPATH)
Target file directory	%(ABSPATH)
Object file directory	%(OBJPATH)
List file directory	%(LSTPATH)
Project construction name	%(PRJCONFIG)
Environment variable	%(ENV[])
Temporary file	%(TEMPFILE)

Note:

When checking [Use the Output window], note the following:

- Once a tool is activated, Make/Build is suspended until the tool is terminated.
- The Output window must not be used with a tool using a wait state for user input while the tool is executing. The user can not perform input while the Output window is in use, so the tool cannot be terminated. To forcibly terminate the tool, select the tool on the Task bar and input Control - C, or Control - Z.

1.5 Include Dependencies Analysis Function

This section describes the function of the Include Dependencies Analysis of SOFTUNE Workbench.

■ Analyzing Include Dependencies

A source file usually includes some include files. When only an include file has been modified leaving a source file unchanged, SOFTUNE Workbench cannot execute the Make function unless it has accurate and updated information about which source file includes which include files.

For this reason, SOFTUNE Workbench has built-in Include Dependencies Analysis function. This function can be activated by selecting the [Project] -[Include Dependencies] menu. By using this function, users can know the exact dependencies, even if an include file includes another include file.

SOFTUNE Workbench automatically updates the dependencies of the compiled/assembled files.

Note:

When executing the [Project] - [Include Dependencies] menu, the Output window is redrawn and replaced by the dependencies analysis result.

If the contents of the current screen are important (error message, etc.), save the contents to a file and then execute the Include Dependencies command.

1.6 Functions of Setting Tool Options

This section describes the functions to set options for the language tools activated from SOFTUNE Workbench.

■ Function of Setting Tool Options

To create a desired target file, it is necessary to specify options for the language tools such as a compiler, assembler, and linker. SOFTUNE Workbench stores and manages the options specified for each tool in project configurations.

Tool options include the options effective for all source files (common options) and the options effective for specific source files (individual options). For details about the option setting, refer to Section "4.5.5 Setup Project" of "SOFTUNE Workbench Operation Manual".

- Common options

  These options are effective for all source files (excluding those for which individual options are specified) stored in the project.

- Individual options

  These options are compile/assemble options effective for specific source files. The common options specified for source files for which individual options are specified become invalid.

■ Tool Options

In SOFTUNE Workbench, the macros indicating that any file name and directory name are specified as options.

If any character string other than parameters is specified, it is passed directly to the tool. For details about the parameters, see Section "1.11 Macro Descriptions Usable in Manager". For details about the tool options for each tool, refer to the manual of each tool.

1.7 Error Jump Function

This section describes the error jump function in SOFTUNE Workbench.

■ Error Jump Function

When an error, such as a compile error occurs, double-clicking the error message displayed in the Output window, automatically opens the source file where the error occurred, and moves the cursor to the error line. This function permits efficient removal of compile errors, etc.

The SOFTUNE Workbench Error Jump function analyzes the source file names and line number information embedded in the error message displayed in the Output window, opens the matching file, and jumps automatically to the line.

The location where a source file name and line number information are embedded in an error message, varies with the tool outputting the error.

An error message format can be added to an existing one or modified into an new one. However, the modify error message formats for pre-installed Fujitsu language tools are defined as part of the system, these can not be modified.

A new error message format should be added when working the Error Jump function with user registered tool. To set Error Jump, execute the [Setup] - [Setup Error Jump] menu.

■ Syntax

An error message format can be described in Syntax. SOFTUNE Workbench uses macro descriptions as shown in the Table 1.7-1 to define such formats.

To analyze up to where %f, %h, and %* continue, SOFTUNE Workbench uses the character immediately after the above characters as a delimiter. Therefore, in Syntax, the description until a character that is used as a delimiter re-appears, is interpreted as a file name or a keyword for help, or is skipped over. To use % as a delimiter, describe as %%. The %[char] macro skips over as long as the specified character continues in parentheses. To specify "]" as a skipped character, describe it as "\]". Blank characters in succession can be specified with a single blank character.

Table 1.7-1 List of Special Characters String for Analyzing Error Message

Parameter	Semantics
%f	Interpret as source file name and inform editor.
%l	Interpret as line number and inform editor.
%h	Become keyword when searching help file.
%*	Skip any desired character.
%[char]	Skip as long as characters in [ ] continues.

[Example]

```
***   %f(%l)   %h: or, %[*]   %f(%l)   %h:
```

The first four characters are "*** ", followed by the file name and parenthesized line number, and then

the keyword for help continues after one blank character.
This represents the following message:
***C:\Sample\sample.c(100) E4062C: Syntax Error: near /int.

1.8 Editor Functions

This section describes the functions of the SOFTUNE Workbench built-in standard editor.

■ Standard Editor

SOFTUNE Workbench has built-in editor called the standard editor. The standard editor is activated as the Edit window in SOFTUNE Workbench. As many Edit windows as are required can be opened at one time.

The standard editor has the following functions in addition to regular editing functions.

- Keyword marking function in C/assembler source file

  Displays reserved words, such as if and for, in different color
- Error line marking function

  The error line can be viewed in a different color, when executing Error Jump.
- Bookmark setup function

  A bookmark can be set on any line, and instantaneously jumps to the line. Once a bookmark is set, the line is displayed in a different color.
- Ruler, line number display function

  The Ruler is a measure to find the position on a line; it is displayed at the top of the Edit window. A line number is displayed at the left side of the Edit window.
- Automatic indent function

  When a line is inserted using the Enter key, the same indent (indentation) as the preceding line is set automatically at the inserted line. If the space or tab key is used on the preceding line, the same use is set at the inserted line as well.
- Function to display, Blank, Line Feed code, and Tab code

  When a file includes a Blank, Line Feed code, and Tab code, these codes are displayed with special symbols.
- Undo function

  This function cancels the preceding editing action to restore the previous state. When more than one character or line is edited, the whole portion is restored.
- Tab size setup function

  Tab stops can be specified by defining how many digits to skip when Tab codes are inserted. The default is 8.
- Font changing function

  The font size for character string displayed in the Edit window can be selected.

1.9 Storing External Editors

This section describes the function to set an external editor to SOFTUNE Workbench.

■ External Editor

SOFTUNE Workbench has built-in standard editor, and use of this standard editor is recommended. However, another accustomed editor can be used, with setting it, instead of an edit window. Use the [Setup] - [Setup Editor] menu to set an external editor.

■ Precautions

There is no particular limit on which editor can be set, but some precautions (below) may be necessary.

- Error jump function

  The Error Jump cannot move the cursor to an error line if the external editor does not have a function to specify the cursor location when activated the external editor.

- File save at compiling/assembling

  SOFTUNE Workbench cannot control an external editor. Always save the file you are editing before compiling/assembling.

■ Setting Options

When activating an external editor from SOFTUNE Workbench, options must be added immediately after the editor name. The names of file to be opened by the editor and the initial location of the cursor (the line number) can be specified. SOFTUNE Workbench has a set of special parameters for specifying any file name and line number, as shown in the Table 1.9-1 . If any other character string are described by these parameters, such characters string are passed as it is to the editor.

%f (File name) is determined as follows:

1. If the focus is on the SRC tab of project window, and if a valid file name is selected, the selected file name becomes the file name.
2. When a valid file name cannot be acquired by the above procedure, the file name with a focus in built-in editor becomes the file name.

%x (project path) is determined as follows:

1. If a focus is on the SRC tab of project window and a valid file name is selected, the project path is a path to the project in which the file is stored.
2. If no path is obtained, the project path is a path to the active project.

Also file name cannot be given double-quotes in the expansion of %f macros.

Therefore, it is necessary for you to provide double-quotes for %f. Depending on the editor, there are line numbers to which there will be no correct jump if the entire option is not given double-quotes.

Table 1.9-1 List of Special Characters for Analyzing Error Message

Parameter	Semantics
%%	Means specifying % itself
%f	Means specifying file name
%l	Means specifying line number
%x	Means specifying project path

■ Example of Optional Settings

Table 1.9-2 Parameters Used in Option Setups (For External Editors)

Editor name	Argument
WZ Editor V4.0	%f /j%l
MIFES V1.0	%f+%l
UltraEdit32	%f/%l/1
TextPad32	%f(%l)
PowerEDITOR	%f -g%l
Codewright32 (PowerEDITOR)	%f -g%l
Hidemaru for Win3.1/95	/j%l:1 %f
ViVi	/line=%l %f

Note:

Regarding execution of error jump in Hidemaru:

To execute error jump in Hidemaru used as an external editor, use the [Others] - [Operating Environment] - [Exclusive Control] menu, and then set "When opening the same file in Hidemaru" and "Opening two identical files is inhibited".

1.10 Storing External Tools

This section describes the function to set an external tool to SOFTUNE Workbench.

■ External Tools

A non-standard tool not attached to SOFTUNE Workbench can be used by setting it as an external tool and by calling it from SOFTUNE Workbench. Use this function to coordinate with a source file version management tool.

If a tool set as an external tool is designed to output the execution result to the standard output and the standard error output through the console application, the result can be specified to output the SOFTUNE Workbench Output window. In addition, the allow description of additional parameters each time the tool is activated.

To set an external tool, use the [Setup] - [Setup Tool] menu.

To select the title of a set tool, use the [Setup] - [Tool execution] menu.

■ Setting Options

When activating an external tool from SOFTUNE Workbench, options must be added immediately after the external tool name. Specify the file names and unique options, etc.

SOFTUNE Workbench has a set of special parameters for specifying any file name and unique tool options.

If any characters string described other than these parameters, such characters string are passed as it is to the external tool.

For details about the parameters, see Section "1.11 Macro Descriptions Usable in Manager".

Note:

When checking [Use the Output window], note the following:

- Once a tool is activated, neither other tools nor the compiler/assembler can be activated until the tool is terminated.
- The Output window must not be used with a tool using a wait state for user input while the tool is executing. The user cannot perform input while the Output window is in use, so the tool cannot be terminated. To forcibly terminate the tool, select the tool on the Task bar and input Control - C, or Control - Z.

1.11 Macro Descriptions Usable in Manager

This section explains the macro descriptions that can be used in the manager of SOFTUNE Workbench.

■ Macros

SOFTUNE Workbench has special parameters indicating that any file name and tool-specific options are specified as options.

The use of these parameters as tool options eliminates the need for options specified each time each tool is started.

The type of macro that can be specified and macro expansion slightly vary depending on where to describe macros. The macros usable for each function are detailed below. For the macros that can be specified for "Error Jump" and "External Editors" see Sections "1.7 Error Jump Function" and "1.9 Storing External Editors".

■ Macro List

The following is a list of macros that can be specified in SOFTUNE Workbench.

The macros usable for each function are listed below.

- External tools: Table 1.11-1 and Table 1.11-2
- Customize build: Table 1.11-1 and Table 1.11-2
- Tool options: Table 1.11-2

The directory symbol \ is added to the option directories in Table 1.11-1 but not to the macro directories in Table 1.11-2 .

The sub-parameters in Table 1.11-3 can be specified in %(FILE), %(LOADMODULEFILE), %(PRJFILE), and %(WSPFILE).

The sub-parameter is specified in the form of %(PRJFILE[PATH]).

If the current directory is on the same drive, the relative path is used. The current directory is the workspace directory for %(PRJFILE) and %(WSPFILE), and the project directory for other than them.

Table 1.11-1 List of Macros that can be Specified 1

Parameter	Meaning
%f	Passed as full-path name of file. *1
%F	Passed as main file name of file. *1
%d	Passed as directory of file. *1
%e	Passed as extension of file. *1
%a	Passed as full-path name of load module file.
%A	Passed as main file name of load module file. *2
%D	Passed as directory of load module file. *2
%E	Passed as extension of load module file. *2
%x	Passed as directory of project file. *2
%X	Passed as main file name of project file. *2
%%	Passed as %.

Table 1.11-2 List of Macros that can be Specified 2

Parameter	Meaning
%(FILE)	Passed as full-path name of file. *1
%(LOADMODULEFILE)	Passed as full-path name of load module file. *2
%(PRJFILE)	Passed as full-path name of project file. *2
%(WSPFILE)	Passed as full-path name of workspace file. *3
%(PRJPATH)	Passed as directory of project file. *2
%(ABSPATH)	Passed as directory of target file. *2
%(OBJPATH)	Passed as directory of object file. *2
%(LSTPATH)	Passed as directory of list file. *2
%(PRJCONFIG)	Passed as project configuration name. *2, *3
%(ENV [Environment variable])	Environment variable value specified in environment variable brackets is passed.
%(TEMPFILE)	Temporary file is created and its full-path name is passed. *4

*1:The macros are determined as follows:

- Customize build
  1. Source file before and after executing compiler and assembler
  2. Target file before and after executing linker, librarian and converter
  3. Configuration file before and after executing configuration
- Tool options

  Null character
- Others
  1. File as focus is on the SRC tab of project window and valid file name is selected
  2. File on which focus is in internal editor as no valid file name can be obtained in 1
  3. Null character if no valid file name can be obtained

*2:The macros are determined as follows:

- Customize build and tool options

  Information on configuration of project under building, making, compiling and assembling
- Others
  1. Information on active configuration of project in which file is stored as focus is on the SRC tab of project window and valid file name is selected
  2. Information on active configuration of active project if no valid file name can be obtained in 1

*3:The macros can use only the project of the workspace project format.

*4:The content of a temporary file can be specified only with customize build.

Table 1.11-3 List of Sub parameters 1

Sub parameter	Meaning
[PATH]	Directory of file
[RELPATH]	Relative path of file
[NAME]	Main file name of file
[EXT]	Extension of file
[SHORTFULLNAME]	Full path name of short file
[SHORTPATH]	Directory of short file
[SHORTNAME]	Main file name of short file
[FOLDER]	Name of folder in which files are stored in the SRC tab of project window (Can be specified only in %(FILE).) *

*: The macros can use only the project of the workspace project format.

■ Examples of Macro Expansion

If a workspace is opened in the following setting, a macro expansion is carried out as shown in examples 1 to 3.

Workspace : C:\Wsp\Wsp.wsp

Active project : C:\Wsp\Sample\Sample.prj

Active project configuration - Debug

Object directory : C:\Wsp\Sample\Debug\Obj\

Subproject : C:\Subprj\Subprj.prj

Active project configuration - Release

Object directory : C:\Subprj\Release\Obj\

Target file : C:\Subprj\Release\Abs\Subprj.abs

[Example 1] Macro expansion in external tools

Focus is on Subprj project file in the SRC tab of project window.

```
%a               :       C:\Subprj\Release\Abs\Subprj.abs
%A               :       SUBPRJ.abs
%D               :       C:\Subprj\Release\Abs\
%E               :       .abs
%(FILE[FOLDER]) :       Source Files\Common
%(PRJFILE)       :       C:\Subprj\Subprj.prj
```

Focus is not in the SRC tab of project window.

```
%a               :       C:\Wsp\Sample\Debug\Abs\Sample.abs
%A               :       Sample.abs
%D               :       C:\Wsp\Sample\Debug\Abs\
%(PRJFILE)       :       C:\Wsp\Sample\Sample.prj
```

[Example 2] Macro expansion in customize build

Release configuration of Subprj project is built.

```
%(FILE)          :       C:\Subprj\LongNameFile.c
%(FILE[PATH])    :       C:\Subprj
%(FILE[RELPATH]):       .
%(FILE[NAME])    :       LongNameFile
%(FILE[EXT])     :       .c
%(FILE[SHORTFULLNAME]): C:\Subprj\LongFi~1.c
%(FILE[SHORTPATH]):     C:\Subprj
%(FILE[SHORTNAME]):     LongFi~1
%(PRJFILE[RELPATH]):    ..\Subprj
%(PRJPATH)       :       C:\Subprj
%(OBJPATH)       :       C:\Subprj\Release\Obj
%(PRJCONFIG)     :       Release
```

```
%(ENV[FETOOL])  :       C:\SOFTUNE
%(TEMPFILE)     :       C:\Subprj\Release\Opt\_fs1056.TMP
```

[Example 3] Macro expansion in tool options

Release configuration of Subprj project is built.

```
%(FILE)          :
%(PRJFILE[RELPATH]):   ..\Subprj
%(PRJPATH)       :      C:\Subprj
%(OBJPATH)       :      C:\Subprj\Release\Obj
%(PRJCONFIG)     :      Release
%(ENV[FETOOL])   :      C:\SOFTUNE
```

1.12 Setting Operating Environment

This section describes the functions for setting the SOFTUNE Workbench operating environment.

■ Operating Environment

Set the environment variables for SOFTUNE Workbench and some basic setting for the workspace.

To set the operating environment, use the **[Setup]-[Setup Development Environment]** menu.

● Environment Variables

Environment variables are variables that are referenced to mainly using the language tools activated from SOFTUNE Workbench. The semantics of an environment variable are displayed in the lower part of the Setup dialog. However, the semantics are not displayed for environment variables used by tools added later to SOFTUNE Workbench.

When SOFTUNE Workbench and the language tools are installed in a same directory, it is not especially necessary to change the environment variable setups.

● Basic setups for workspace

The following setups are possible.

- Open the previously workspace at start up

  When starting SOFTUNE Workbench, it automatically opens the last opened workspace.
- Display options while compiling/assembling

  Compile options or assemble options can be viewed in the Output window.
- Save dialog before closing workspace

  Before closing the workspace, a dialog asking for confirmation of whether or not to save the workspace to the file is displayed. If this setting is not made, SOFTUNE Workbench automatically saves the workspace without any confirmation message.
- Save dialog at compiling/assembling

Before compiling/assembling, a dialog asking for confirmation of whether or not to save a source file that has not been saved is displayed. If this setting is not made, the file is saved automatically at compile/assemble/make/build.

- Termination message is highlighted at Make/Build

  At Compile, Assemble, Make, or Build, the display color of termination messages (Abort, No Error, Warning, Error, Fatal error, or Failing During start) can be changed freely by the user.

■ Reference Section

Development Environment

Note:

Because the environment variables set here are language tools for the SOFTUNE Workbench, the environment variables set on previous versions of SOFTUNE cannot be used. In particular, add the set values of [User Include Directory] and [Library Search Directory] to [Project Settings].

1.13 Debugger Types

This section describes the types of SOFTUNE Workbench debuggers.

■ Type of Debugger

SOFTUNE Workbench integrates three types of debugger: a simulator debugger, emulator debugger and monitor debugger.

Any one can be selected depending on the requirement.

■ Simulator Debugger

The simulator debugger simulates the MCU operations (executing instructions, memory space, I/O ports, interrupts, reset, etc.) with software to evaluate a program.

It is used for evaluating an uncompleted system and operation of individual units, etc.

■ Emulator Debugger

The emulator debugger is software to evaluate a program by controlling the emulator from a host computer through a communications line (RS-232C, LAN, USB).

Before using this debugger, the emulator must be initialized.

■ Monitor Debugger

The monitor debugger evaluates a program by putting it into an evaluation system and communicating with a host.

An RS-232C interface and an area for the debug program are required within the evaluation system.

1.14 Memory Operation Functions

This section describes the memory operation functions.

■ Functions for Memory Operations

- Display/Modify memory data

  Memory data can be display in the Memory window and modified.
- Fill

  The specified memory area can be filled with the specified data.
- Copy

  The data in the specified memory area can be copied to another area.
- Compare

  The data in the specified source area can be compared with data in the destination area.
- Search

  Data in the specified memory area can be searched.

For further details of the above functions, refer to "3.11 Memory Window" in "SOFTUNE Workbench Operation Manual".

- Display/Modify C variables

  The names of variables in a C source file can be displayed in the Watch window and modified.
- Setting Watch point

  By setting a watch point at a specific address, its data can be displayed in the Watch window.

For further details of the above functions, refer to "3.13 Watch Window" in "SOFTUNE Workbench Operation Manual".

1.15 Register Operations

This section describes the register operations.

■ Register Operations

The Register window is opened when the [View] - [Register] menu is executed. The register and flag values can be displayed in the Register window.

For further details about modifying the register value and the flag value, refer to "4.4.4 Register" in "SOFTUNE Workbench Operation Manual".

The name of the register and flag displayed in the Register window varies depending on each MCU in use. For the list of register names and flag names for the MCU in use, refer to "Appendix A Register Name List" of "SOFTUNE Workbench Operational Manual".

1.16 Line Assembly and Disassembly

This section describes line assembly and disassembly.

■ Line Assembly

To perform line-by-line assembly (line assembly), right-click anywhere in the Disassembly window to display the short-cut menu, and select [Inline Assembly]. For further details about assembly operation, refer to "4.4.3 Assembly" in "SOFTUNE Workbench Operation Manual".

■ Disassembly

To display disassembly, use the [View]-[Assembly] menu. By default, disassembly can be viewed starting from the address pointed by the current program counter (PC). However, the address can be changed to any desired address at start-up.

Disassembly for an address outside the memory map range cannot be displayed. If this is attempted, "???" is displayed as the mnemonic.

1.17 Symbolic Debugging

The symbols defined in a source program can be used for command parameters (address). There are three types of symbols as follows:

- **Global Symbol**
- **Static Symbol within Module (Local Symbol within Module)**
- **Local Symbol within Function**

■ Types of Symbols

A symbol means the symbol defined while a program is created, and it usually has a type. Symbols become usable by loading the debug information file.

Furthermore, for symbol of C language, it recognizes the type and executes the command.

There are three types of symbols as follows:

- Global symbol

  A global symbol can be referenced to from anywhere within a program. In C language, variables and functions defined outside a function without a static declaration are in this category. In assembler, symbols with a PUBLIC declaration are in this category.

- Static symbol within module (Local symbol within module)

  A static symbol within module can be referenced to only within the module where the symbol is defined.

  In C language, variables and functions defined outside a function with a static declaration are in this category. In assembler, symbols without a PUBLIC declaration are in this category.

- Local symbol within function

  A local symbol within a function exists only in C language. A static symbol within a function and an automatic variable are in this category.

  - Static symbol within function

    Out of the variables defined in function, those with static declaration.

  - Automatic variable

    Out of the variables defined in function, those without static declaration and parameters for the function.

■ Setting Symbol Information

Symbol information in the file is set with the symbol information table by loading a debug information file. This symbol information is created for each module.

The module is constructed for each source file to be compiled in C language, in assembler for each source file to be assembled.

The debugger automatically selects the symbol information for the module to which the PC belongs to at abortion of execution (Called "the current module"). A program in C language also has information about which function the PC belongs to.

■ Line Number Information

Line number information is set with the line number information table in SOFTUNE Workbench when a debug information file is loaded. Once registered, such information can be used at anytime thereafter. Line number is defined as follows:

[Source File Name] $Line Number

1.17.1 Referring to Local Symbols

This section describes referring to local symbols and Scope.

■ Scope

When a local symbol is referenced to, Scope is used to indicate the module and function to which the local symbol to be referenced belongs.

SOFTUNE Workbench automatically scopes the current module and function to refer to local symbols in the current module with preference. This is called the Auto-scope function, and the module and function currently being scoped are called the Current Scope.

When specifying a local variable outside the Current Scope, the variable name should be preceded by the module and function to which the variable belongs. This method of specifying a variable is called a symbol path name or a Search Scope.

■ Moving Scope

As explained earlier, there are two ways to specify the reference to a variable: by adding a Search Scope when specifying the variable name, and by moving the Current Scope to the function with the symbol to be referenced to. The Current Scope can be changed by displaying the Call Stack dialog and selecting the parent function. For further details of this operation, refer to "4.6.7 Stack" in "SOFTUNE Workbench Operation Manual". Changing the Current Scope as described above does not affect the value of the PC.

By moving the current scope in this way, you can search a local symbol in parent function with precedence.

■ Specifying Symbol and Search Procedure

A symbol is specified as follows:

[[Module Name] [\Function Name] \] Symbol Name

When a symbol is specified using the module and function names, the symbol is searched. However, when only the symbol name is specified, the search is made as follows:

1. Local symbols within function in Current Scope
2. Static symbols within module in Current Scope
3. Global symbols

If a global symbol has the same name as a local symbol in the Current Scope, specify "\" or "::" at the start of global symbol. By doing so, you can explicitly show that is a global symbol.

An automatic variable can be referenced to only when the variable is in memory. Otherwise, specifying an automatic variable causes an error.

1.17.2 Referring to Variables of C Language

Variables of C language can be specified using the same descriptions as in the source program written in C language.

■ Specifying Variables of C Language

Variables of C language can be specified using the same descriptions as in the source program. The address of variables of C language should be preceded by the ampersand symbol "&". Some examples are shown in the Table 1.17-1 .

Table 1.17-1 Examples of Specifying Variables

Example of Variables		Example of Specifying Variables	Semantics
Regular Variable	int data;	data	Value of data
Pointer	char *p;	*p	Value pointed to by p
Array	char a[5];	a[1]	Value of second element of a

Structure	struct stag {
	  char c;
	  int i;
	};
	struct stag st;
	struct stag *stp;
		st.c
		stp- >c
			Value of member c of st
			Value of member c of the structure to which stp points

Union	union utag {
	  char c;
	  int i;
	} uni;
		uni.i	Value of member i of uni

Address of variable	int data;	&data	Address of data
Reference type	int i; int &ri = i;	ri	Same as i

■ Notes on Symbols of C Language

The C compiler outputs symbol information with "_" prefixed to global symbols. For example, the symbol main outputs symbol information _main. However, SOFTUNE Workbench permits access using the symbol name described in the source to make program debugging described in C easier.

Consequently, a symbol name described in C language and a symbol name described in assembler, which should both be unique, may be identical.

In such a case, the symbol name in the Current Scope normally is preferred. To refer to a symbol name outside the Current Scope, specify the symbol with the module name.

If there are duplicated symbols outside the Current Scope, the symbol name searched first becomes valid. To refer to another one, specify the symbol with the module name.

CHAPTER 2
DEPENDENCE FUNCTIONS

This chapter describes the functions dependent on F^{2}MC-8L/8FX family MCU.

2.1 Simulator Debugger

2.2 Emulator Debugger (MB2141)

2.3 Emulator Debugger (MB2146-09/09A/09B)

2.4 Emulator Debugger (MB2146-08)

2.5 Emulator Debugger (MB2146-07)

2.6 Monitor Debugger

2.1 Simulator Debugger

This section describes the functions of the simulator debugger.

■ Simulator Debugger

The simulator debugger simulates the MCU operations with software to evaluate a program.

It is used to evaluate an uncompleted system, the operation of single units, etc.

■ Simulation Range

The simulator debugger simulates the MCU operations (instruction operations, memory space, interrupts, reset, power-save consumption mode, etc.) with software. Peripheral I/Os, such as a timer, DMAC and serial I/O, other than the CPU core of the actual chip are not supported as peripheral resources. I/O space to which peripheral I/Os are connected is treated as memory space. There is a method for simulating interrupts like timer interrupts, and data input to memory like I/O ports. For details, see the sections concerning I/O port simulation and interrupt simulation.

- Instruction simulation
- Memory simulation
- I/O port simulation (Input port)
- I/O port simulation (Output port)
- Interrupt simulation
- Reset simulation
- Power-save mode simulation

Note:

- Of the low-power consumption modes, the following modes are excluded from the simulation target.
  - Clock mode
  - Time-base timer mode

2.1.1 Instruction Simulation

This section describes the instruction simulation executed.

■ Instruction Simulation

This simulates the operations of all instructions supported by the F^2MC-8L/8FX. It also simulates the changes in memory and register values due to such instructions.

2.1.2 Memory Simulation

This section describes the memory simulation executed.

■ Memory Simulation

The simulator debugger must first secure memory space to simulate instructions because it simulates the memory space secured in the host machine memory.

One of the following operations is required.

- To secure the memory area, either use the [Setup] - [Memory Map] menu, or the SET MAP command in the Command window.
- Load the file output by the Linkage Editor (Load Module File) using either the [Debug] - [Load target file] menu, or the LOAD/OBJECT command in the Command window.

■ Simulation Memory Space

Memory space access attributes can be specified byte-by-byte using the [Setup] - [Memory Map] menu. The access attribute of unspecified memory space is undefined.

The access attributes of the memory space, which was not specified by using the [Setup] - [Memory Map] menu, remain undefined.

■ Memory Area Access Attributes

Access attributes for memory area can be specified as shown in Table 2.1-1. A guarded access break occurs if access is attempted against such access attribute while executing a program. When access is made by a program command, such access is allowed regardless of the attribute, CODE, READ or WRITE. However, access to memory in an undefined area causes an error.

Table 2.1-1 Types of Access Attributes

Attribute	Semantics
CODE	Instruction operation enabled
READ	Data read enabled
WRITE	Data write enabled
undefined	Attribute undefined (access prohibited)

2.1.3 I/O Port Simulation

This section explains I/O port simulation executed.

■ I/O Port Simulation

The MCU operation against input port and output port is simulated.

- Input port

  The following input port simulation methods are available.

  - Whenever a program writes data to the specified port, writing is executed to the specified data output destination.
  - Whenever instruction execution cycle count exceeds the specified cycle count, data is input to the port.

- Output port

  The following output port simulation methods are available.

  - Whenever a program calls the specified port, data is input from the specified data input source.

Up to 4096 port addresses can be set.

■ Input Source or Output Destination

Input source at the input port, or output destination at the output port, can be specified to the following.

- File
  - A text file that can be created using an ordinary editor.
    Set the input data's delimiter to "," (comma). After reading the last data from the file, the data is read again from the beginning of the file.
  - Binary file containing direct code
- Terminal

■ I/O Port Settings

I/O port settings can be configured using the following.

- Dialog
  - I/O port configuration dialog
    Refer to "4.7.2.1 I/O Port" in "SOFTUNE Workbench Operation Manual".
- Command
  - SET INPORT or SET OUTPORT
    Refer to "1.20 SET INPORT" or "1.23 SET OUTPORT" in "SOFTUNE Workbench Command Reference Manual".

2.1.4 Interrupt Simulation

This section explains interrupt simulation.

■ Interrupt Simulation

The MCU operation in response to an interrupt request is simulated.

Interrupts can be generated as follows:

- While the program is being executed with a specified cycle count, interrupts are generated per specified interrupt number, and overrides the interrupt generating conditions.
- Interrupts are generated every time when the command execution cycle count exceeds the specified cycle count.

If interrupts are masked by the interrupt enable flag when the interrupt-generating conditions are established, the interrupts are suspended.

■ Control Methods of Interrupts

Interrupts are configured using the following methods.

- Dialog
  - Interrupt dialog
    Refer to section "4.7.2.2 Interrupts" of "SOFTUNE Workbench Operation Manual".
- Command
  - SET INTERRUPT
    Refer to section "1.26 SET INTERRUPT" of "SOFTUNE Workbench Command Reference Manual".

2.1.5 Reset Simulation

This section explains reset simulation.

■ Reset Simulation

The operation of when MCU receives a reset signal is simulated.

At the moment, register is initialized.

The reset execution function by operation of MCU instructions, such as writing to RST bit in the standby control register, is also supported.

■ Reset Control

Reset control can be achieved as follows.

- Menu
  - [Debug] - [Reset MCU] menu
    Refer to section "4.6.3 Reset of MCU" of "SOFTUNE Workbench Operation Manual".
- Command
  - RESET
    Refer to section "1.3 RESET" of "SOFTUNE Workbench Command Reference Manual."

2.1.6 Low-Power Consumption Mode Simulation

This section describes the low-power consumption mode simulation.

■ Low-Power Consumption Mode Simulation

This simulator debugger can simulate the low-power consumption mode.

Shifting to the low-power consumption mode can be done by writing to the standby control register.

- When SLEEP bit is written

  Sleep mode is enabled, and [sleep] appears in the status bar.
- When STOP bit is written

  Stop mode is enabled, and [stop] appears in the status bar.

Upon execution of the program, interrupt request is generated, or it goes into a loop until the program execution is terminated. Each cycle loop increments the cycle count by 1.

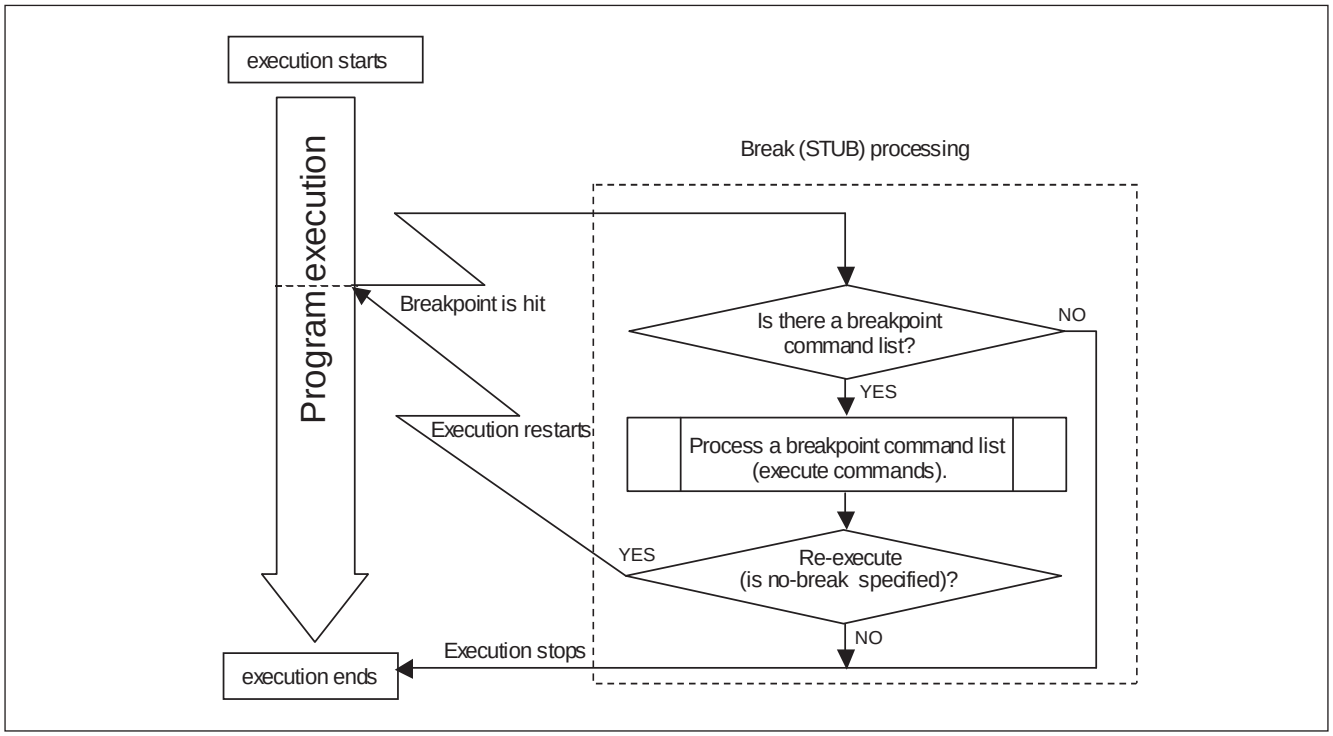
During this period, I/O port processing can also be operated.

2.1.7 STUB Function

This section describes the STUB function which executes commands automatically when the breakpoint hit occurs.

■ Outline of STUB Function

The STUB function is supported so that a series of commands in the command list can automatically be executed when a specified breakpoint is hit. The use of this function enables spot processing, such as simple I/O simulation, external interrupt generation, and memory reprogramming, without changing the main program. This function is effective only when the simulator debugger is used.



■ Setting Method

The STUB function can be set by any of the following commands.

- Dialog
  - Break Setting Dialog
    Refer to "4.6.4 Breakpoint" of "SOFTUNE Workbench Operation Manual".
- Command
  - SET BREAK
  - SET DATABREAK
    Refer to "3.1 SET BREAK (type 1)" or "3.10 SET DATABREAK (type 2)" of "SOFTUNE Workbench Command Reference Manual".

2.1.8 Break

This Debugger provides five types of break functions. When by each break function aborts program execution, the address where a break occurred and the break factor are displayed.

■ Break Functions

This Debugger provides the following five types of break functions;

- Code break
- Data break
- Guarded access break
- Trace buffer-full break
- Forced break

2.1.8.1 Code Break

It is a function that the simulator debugger aborts the program execution when the code access specified while executing the program is done.

■ Flow of Code Break

When the program reaches the breakpoint (Immediately before an instruction memory positional is executed), the simulator debugger does the following processing.

1. The execution of the program is aborted (Before executing the instruction).
2. When the attainment frequency is checked, and it doesn't reach the attainment frequency of the specified breakpoint, the program execution is restarted. It moves to 3 when it reaches the attainment frequency.
3. The memory position in which execution was aborted is displayed in the status bar.
   The breakpoint can be set up to 65535 points or less.

When the code break occurs, the following message appears at the status bar.

Break at address by breakpoint

■ Setting Method

Set code break as follows.

- Command
  - SET BREAK
    Refer to "3.1 SET BREAK (type 1)" of "SOFTUNE Workbench Command Reference Manual".
- Dialog
  - "Code" tab in breakpoint setting dialog
    Refer to "4.6.4 Breakpoint" of "SOFTUNE Workbench Operation Manual".
- Window
  - Source window/disassemble window
    Refer to "3.7 Source Window" or "3.9 Disassemble Window" of "SOFTUNE Workbench Operation Manual".

2.1.8.2 Data Break

It is a function that the simulator debugger aborts the program execution when the data access (read and write) specified while executing the program is done.

■ Flow of Data Break

The simulator debugger does the following processing when the program performs read/write in the breakpoint.

1. After the execution of the instruction is completed, the execution of the program is aborted.
2. It moves to 3 when the program execution is restarted when the access frequency is checked, and it doesn't reach the access frequency of the specified data break, and it reaches the access frequency.
3. When it reaches the access frequency and the program execution is aborted, the following information is displayed in the status bar:
   - The memory position of the data breakpoint
   - The memory position of the instruction in which it is writing (Or, reading)
4. Next, the executed memory position is displayed.
   Up to 65535 data break points can be set.

When the data break occurs, the following message appears at the status bar.

Break at address by databreak at access address

■ Setting Method

Set the data break as follows.

- Command
  - SET DATABREAK
    Refer to "3.10 SET DATABREAK(type 2)" of "SOFTUNE Workbench Command Reference Manual".
- Dialog
  - "Data" tab in breakpoint setting dialog
    Refer to "4.6.4 Breakpoint" of "SOFTUNE Workbench Operation Manual".

2.1.8.3 Guarded Access Break

It is a function to abort the program execution when the violation to the access attribute, doing the access, and guarded (An undefined area cannot be accessed) area are accessed.

■ Guarded Access Breaks

It is a function to abort the program execution when the violation to the access attribute, doing the access, and guarded (An undefined area cannot be accessed) area are accessed.

Guarded access break occurs in the following cases:

- Code Guarded
  An instruction has been executed for an area having no code attribute.
- Read Guarded
  A read has been attempted from the area having no read attribute.
- Write Guarded
  A write has been attempted to an area having no write attribute.

When a break occurs due to a guarded break, the following message is displayed on the Status Bar.

Break at Address by guarded access {code/read/write} at Access Address

■ Setting Method

Set the access attribute as follows.

- Command
  - SET MAP
    Refer to "1.13 SET MAP (type 1)" of "SOFTUNE Workbench Command Reference Manual".
- Dialog
  - MAP Setting Dialog
    Refer to "4.7.3 Memory Map" of "SOFTUNE Workbench Operation Manual".

2.1.8.4 Trace Buffer-full Break

This function aborts the program execution when the trace buffer becomes buffer-full.

■ Trace Buffer-full Break

This function aborts the program execution when the trace buffer becomes buffer-full.

When the trace buffer-full break occurs, the following message appears at the status bar.

Break at address by trace buffer full

■ Setting Method

Set the trace buffer-full break as follows.

- Command
  - SET TRACE/BREAK
    Refer to "4.21 SET TRACE" of "SOFTUNE Workbench Command Reference Manual".
- Dialog
  - Trace setting dialog
    Refer to "4.4.8 Trace" of "SOFTUNE Workbench Operation Manual".

2.1.8.5 Forced Break

This function forcibly aborts the program execution to generate a break.

■ Forced Break

This function forcibly aborts the program execution to generate a break.

When the forced break occurred, the following message appears at the status bar.

Break at address by command abort request

■ Generation Method

The methods of generating forced breaks are as follows.

- Menu
  - [Debug]-[Abort] menu
    Refer to "4.6.2 Abort" of "SOFTUNE Workbench Operation Manual".
- Command
  - ABORT
    Refer to "2.2 ABORT" of "SOFTUNE Workbench Command Reference Manual".

2.1.9 Measuring the Number of Execution Cycles

This function measures the number of program execution cycles.

■ Items to be Measured

Program execution cycle count and step count are measured.

1. Execution cycle count

   Basic cycle count of each instruction, as stated in the programming manual, is calculated.

   The maximum measurement value is 2^{32} -1, i.e., 4,294,967,295 cycles.

2. Execution step count

   Program execution step count is measured.

   Up to 2^{32} -1, i.e., 4,294,967,295 steps, can be measured.

   Measurement is done for each program execution, and the results indicate the following.

   - The previously recorded program execution step count
   - The sum of execution step count after the recent clearance.

■ Displaying of Measurement Result

The measurement result can be displayed using the following method.

- Dialog
  - Time measurement dialog
    Refer to section "4.6.8 Time Measurement" of "SOFTUNE Workbench Operation Manual".
- Command
  - SHOW TIMER
    Refer to "4.19 SHOW TIMER" of "SOFTUNE Workbench Command Reference Manual".

■ Clearing of Measurement Result

The measurement result can be cleared using the following method.

- Dialog
  - Time measurement dialog
    Refer to section "4.6.8 Time Measurement" of "SOFTUNE Workbench Operation Manual".
- Command
  - CLEAR TIMER
    Refer to "4.20 CLEAR TIMER" of "SOFTUNE Workbench Command Reference Manual".

2.1.10 To Refer to a Program Execution History, Use [TRACE]

This section describes the trace function of this simulator debugger.

■ Trace Functions

Trace is a function that records program execution record.

Trace data includes the following information that can be used to analyze the program execution record.

- Record of addresses where programs were executed: this includes the record before/after branch instructions
- Data accessed while programs are executed: only the specified attributes are included

■ Acquisition of Trace Data

Trace data acquisition is started/ended at the following timing.

- Acquisition starts
  - When a user program is executed
- Acquisition ends
  - When a user program is stopped

■ Trace Buffer

A single data unit stored in the trace buffer is called a frame.

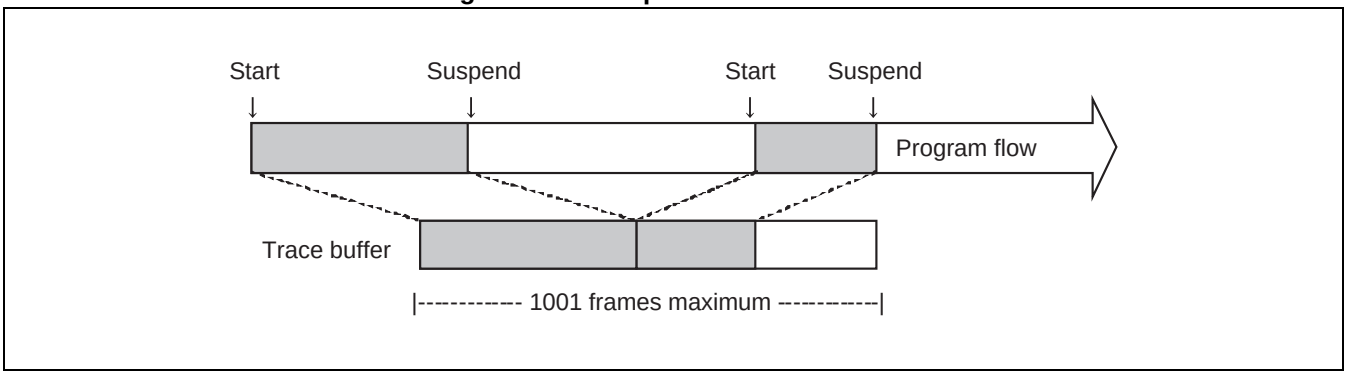
The trace buffer can contain up to 1001 frames.

Trace buffer is a ring buffer; when it becomes buffer-full, the new record automatically replaces the oldest record in the buffer.

Figure 2.1-1 describes how data is stored in the trace buffer.

- When break halts program execution

Figure 2.1-1 Acquisition of trace data



2.1.10.1 Displaying Trace Data

This section describes how to display trace data.

■ Display Formats of Trace Data

Two trace data diplay formats are available as follows.

Instruction : displays trace data in the order of command execution

Source : displays trace data by source row

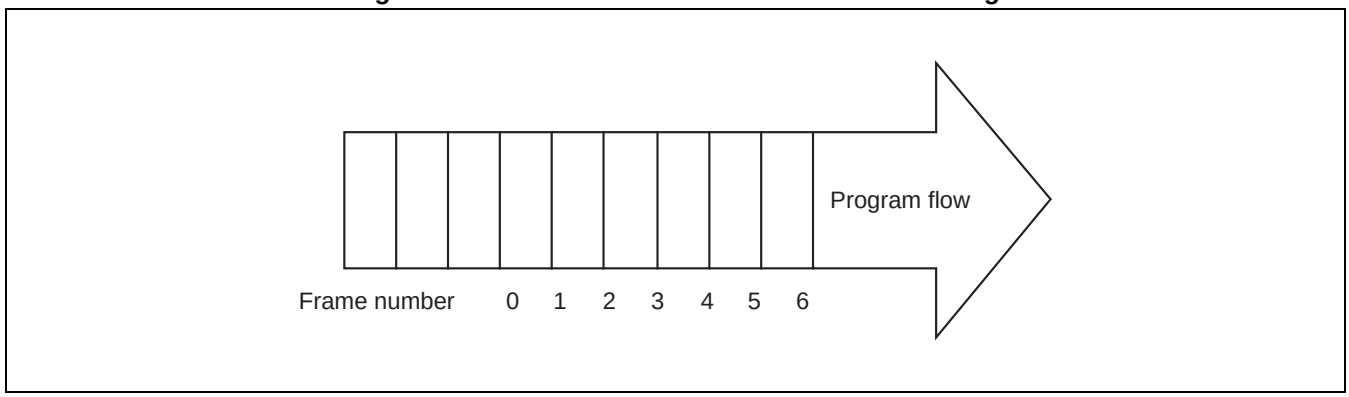
■ Display Position of Trace Data

Each of the sampled trace data is numbered per frame. This number is called a frame number.

By specifying a frame number, display positioning within the trace buffer can be specified.

The most recently sampled trace data is numbered as 0.

Figure 2.1-2 Frame Numbers at the Time of Tracing



■ Display Methods of Trace Data

Trace data can be displayed in the trace window or the command window.

The following methods can be used. In either case, the same data can be accessed.

- Displaying via the trace window
  1. Display the trace window.
     - Select [Display] - [Trace] in the menu.
  2. Select the display mode of the trace window.
     - Right-click on the trace window. In the pop-up menu, select either [Instruction] or [Source].
       Refer to section "3.14 Trace Window" of "SOFTUNE Workbench Operation Manual" for detailed information.
  3. Trace data can be updated (if the trace window is already displayed).
     - Right-click on the trace window. In the pop-up menu, select [Update]. Trace data in the trace window is updated.
       Refer to section "3.14 Trace Window" of "SOFTUNE Workbench Operation Manual" for detailed information.

- Displaying via the command window
  1. Display the trace data per display mode.

     For instruction: SHOW TRACE

     For source: SHOW TRACE

     Refer to section "4.15 SHOW TRACE (type2)" of "SOFTUNE Workbench Command Reference Manual" for detailed information.

2.1.10.2 Saving Traced Data

This section explains the methods to save trace data.

■ To Save Trace Data

Trace data can be saved into a specified file.

Both GUI (via window or dialog) and command-only methods can be used. These methods give the same results.

- Saving via GUI
  1. Display the trace window.
     - Select [Display] - [Trace] in the menu.
  2. Specify a file name to which the trace data will be saved.
     - Right-click on the trace window, and select [save] in the pop-up menu. "Save As..." dialog is displayed.
       Here, specify the file name and directory to where you wish to store the file. Refer to section "4.4.8 Trace" of "SOFTUNE Workbench Operation Manual" for detailed information.

- Saving via command
  Save the trace data.
  - Execute SHOW TRACE/FILE command.
    Refer to section "4.16 SHOW TRACE (type 1)" of "SOFTUNE Workbench Command Reference Manual" for detailed information.
    To append and save data to an existing file, execute SHOW TRACE/FILE/APPEND command.

2.1.10.3 Searching Traced Data

This section explains the methods to search trace data.

■ Searching of Trace Data

This function searches for trace data with a specified address or frame number.

Both GUI (via window or dialog) and command-only methods can be used. These methods give the same results.

- Searching via GUI
  1. Display the trace window.
     - Select [Display] - [Trace] in the menu.
  2. Specify the address or the frame number that you wish to search.
     - Right-click on the trace window, and select [search] in the pop-up menu. Trace search dialog is displayed.
       Here, specify the address or the frame number that you wish to be displayed. Refer to section "4.4.8 Trace" of "SOFTUNE Workbench Operation Manual" for detailed information.

- Searching via command
  Search the trace data.
     - Execute SEARCH TRACE command.
       Refer to section "4.23 SEARCH TRACE" of "SOFTUNE Workbench Command Reference Manual" for detailed information.

2.1.10.4 To Terminate Trace Obtention

This section describes the buffer full break which terminates trace obtention when the trace buffer becomes full.

■ Buffer-full Break

When the trace buffer becomes full, trace obtention can be terminated. This function is called trace buffer-full break.

■ Configuration

Controlling of trace buffer-full break can be done using the following methods.

- Setting via GUI
  1. Display the trace window.
     - Select [Display] - [Trace] in the menu.
  2. Trace configuration dialog is displayed.
     - Right-click on the trace window, and select [Setup] in the short-cut menu. In the trace setup dialog displayed, select [Enabled] under [Buffer-full break].
       Refer to section "4.4.8 Trace" of "SOFTUNE Workbench Operation Manual" for detailed information.

- Setting via command
  Configure trace buffer-full break.
     - Execute SET TRACE /BREAK command.
       Refer to section "4.21 SET TRACE" of "SOFTUNE Workbench Command Reference Manual" for detailed information.

2.1.11 Confirming the Debugger's State

This section explains various methods of confirming the debugger's state and its information.

■ Debugger Information

The following information can be obtained at the debugger's startup.

- File information of SOFTUNE Workbench

  If problems are encountered with SOFTUNE Workbench and its behavior, refer to the information before contacting the Sales Representatives.

■ Confirmation Method

Debugger's information can be confirmed as follows.

- Command
  - SHOW SYSTEM

    Refer to section "1.12 SHOW SYSTEM" of "SOFTUNE Workbench Command Reference Manual".
- Dialog
  - Version information dialog

    Refer to section "4.9.3 Version Information" of "SOFTUNE Workbench Operation Manual".

■ Content to be Displayed

```
F2MC-8L/8FX Family SOFTUNE Workbench VxxLxx
ALL RIGHTS RESERVED,
  COPYRIGHT(C) FUJITSU SEMICONDUCTOR LIMITED 1997
LICENCED MATERIAL -
  PROGRAM PROPERTY OF FUJITSU SEMICONDUCTOR LIMITED
=======================================================
Cpu information file path    : Path to the CPU information file
Cpu information file version : Version of the CPU information file
=======================================================
Add in DLLs
-------------------------------------------------------
 SiCmn
 Product name    : SOFTUNE Workbench
 File Path       : Path to SiC896.dll
 Version         : Version of SiC896.dll
- - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 SiiEd
 File Path       : Path to SiiEd3.ocx
 Version         : Version of SiiEd3.ocx
-------------------------------------------------------
 SiM896
 Product name    : SOFTUNE Workbench
 File Path       : Path to SiM896.dll
 Version         : Version of SiM896.dll
- - - - - - - - - - - - - - - - - - - - - - - - - - - - -
Language Tools
 - Compiler
   File Path     : Path to fcc896s.exe
 - Assembler
   File Path     : Path to fasm896s.exe
 - Linker
   File Path     : Path to flnk896s.exe
 - Librarian
   File Path     : Path to flib896s.exe
 - FJ-OMF to S-FORMAT Converter
```

```
   File Path     : Path to f2ms.exe
 - FJ-OMF to INTEL-HEX Converter
   File Path     : Path to f2is.exe
 - FJ-OMF to INTEL-EXT-HEX Converter
   File Path     : Path to f2es.exe
 - FJ-OMF to HEX Converter
   File Path     : Path to f2hs.exe
-------------------------------------------------------
 SiOsM
 Product name    : SOFTUNE Workbench
 File Path       : Path to SiOsM896.dll
 Version         : Version of SiOsM896.dll
-------------------------------------------------------
 F2MC-8L/8FX Series Debugger DLL
 Product name    : SOFTUNE Workbench
 File Path       : Path to SiD896.dll
 Version         : Version of SiD896.dll
- - - - - - - - - - - - - - - - - - - - - - - - - - - - -
Debugger type    : Current debugger type
MCU type         : Currently selected target MCU
VCpu dll name    : Path and name of currently selected virtual debugger section DLL
VCpu dll version : Version of currently selected virtual debugger section DLL
-------------------------------------------------------
 SiIODef
 Product name    : SOFTUNE Workbench
 File Path       : Path to SiIODef.dll
 Version         : Version of SiIODef.dll
=======================================================
Current path     : Currently specified project path
Language         : Currently selected language
Help file path   : Path to the help files
```

2.2 Emulator Debugger (MB2141)

This section explains the functions of the emulator debugger (MB2141).

■ Emulator Debugger

The emulator debugger is a software to evaluate a program by controlling an emulator from a host computer via a communications line (RS-232C, LAN).

■ Before Use

When using MB2141, first initialize the emulator by referring to "Appendix B Downloading Monitor Program" and "Appendix C Setting LAN Interface"of "SOFTUNE Workbench Operation Manual".

2.2.1 Setting Operating Environment

This section explains the operating environment setup.

■ Operating Environment

For the emulator debugger for the MB2141, it is necessary to set the following items according the operating environment. Predefined default settings for all these setup items are enabled at startup. Therefore, it is not required to change the settings when using the default settings. Adjusted settings can be used as new default settings from the next time.

- MCU operation mode
- Memory Mapping
- Timer Minimum Measurement Unit

2.2.1.1 MCU Operation Mode

This section explains MCU operation mode.

■ MCU Operation Mode

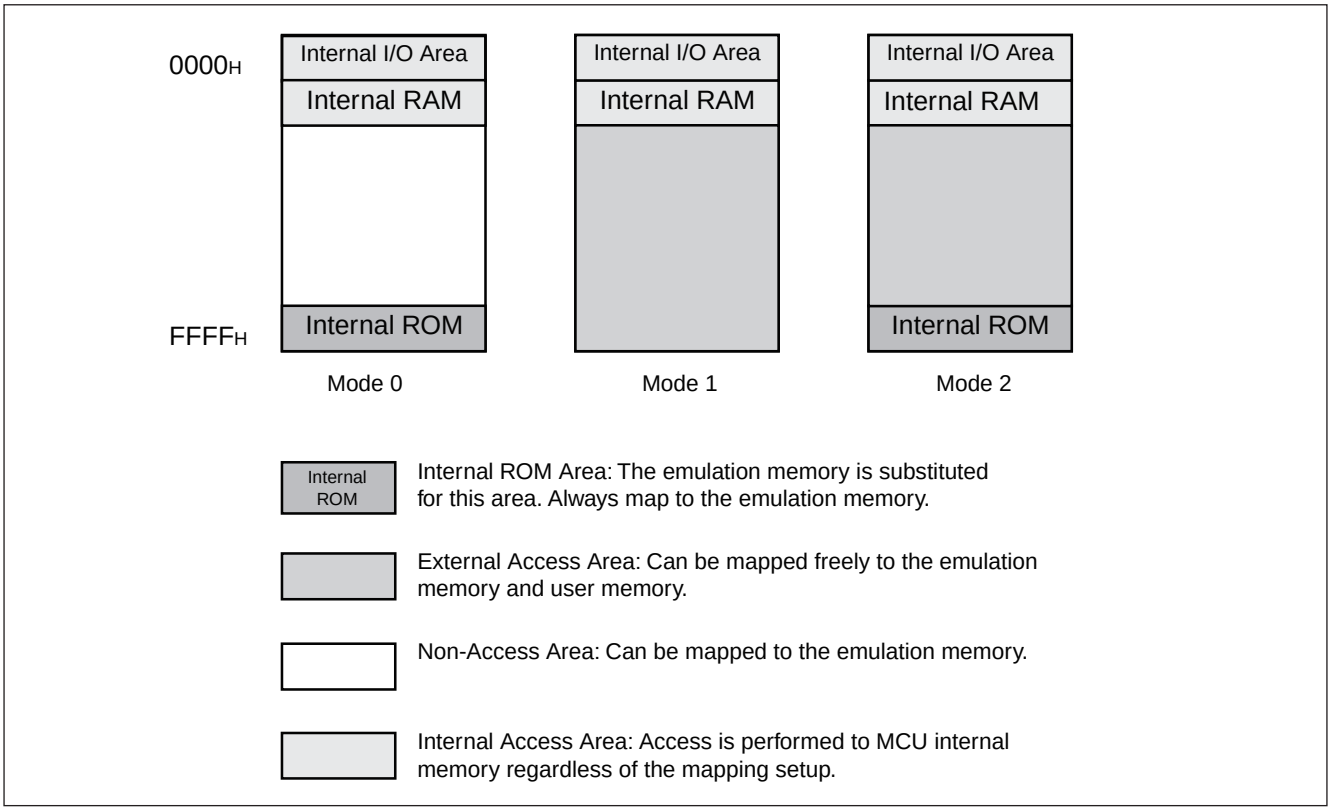
There are three MCU operation modes as follows:

- Single chip mode (Mode 0)
- External ROM mode (Mode 1)
- Internal ROM mode with external access function (Mode 2)

The MCU operation mode varies depending on the product type.

Refer to the Hardware Manual for each MCU for further details.

Figure 2.2-1 MCU Modes and Memory Mapping


0000H
FFFFH
Internal I/O Area
Internal RAM
Internal ROM
Mode 0
Mode 1
Mode 2
Internal ROM
Internal ROM Area: The emulation memory is substituted for this area. Always map to the emulation memory.
External Access Area: Can be mapped freely to the emulation memory and user memory.
Non-Access Area: Can be mapped to the emulation memory.
Internal Access Area: Access is performed to MCU internal memory regardless of the mapping setup.

As shown in Figure 2.2-1, memory mapping operation varies depending on MCU mode. Internal RAM area (internal RAM, internal register, and internal I/O) cannot map to the emulation memory because it accesses internal MCU regardless of mapping setup.

2.2.1.2 Memory Area Types

This section explains memory area.

■ Memory Area Types

A unit to allocate memory is called an area. Up to 20 areas can be set in 1-byte units. There is no limit on the size of an area. An access attribute can be set for each area.

There are three different area types as follows:

- User Memory Area

  Memory space in the user system is called the user memory area and this memory is called the user memory.

  To set the user memory area, use the SET MAP command.

- Emulation Memory Area

  Memory space substituted for emulator memory is called the emulation memory area, and this memory is called emulation memory.

  The user system bus master (DMAC, etc.) cannot access emulation memory.

  To set the emulation memory area, use the SET MAP command.

- Undefined Area

  A memory area that does not belong to any of the areas described above is part of the user memory area. This area is specifically called the undefined area.

  The undefined area can be set to either NOGUARD area, which can be accessed freely, or GUARD area, which cannot be accessed. Select either setup for the whole undefined area. If the area attribute is set to GUARD, a guarded access error occurs if access to this area is attempted.

2.2.1.3 Memory Mapping

Memory space can be allocated to the user memory and the emulation memory, etc., and the attributes of these areas can be specified.
However, the MCU internal resources are not dependent on this mapping setup and access is always made to the internal resources.

■ Access Attributes for Memory Areas

The access attributes shown in Table 2.2-1 can be specified for memory areas.

A guarded access break occurs if access is attempted in violation of these attributes while executing a program.

When access to the user memory area and the emulation memory area is made using program commands, such access is allowed regardless of the READ, WRITE attributes. However, access to memory with the GUARD attribute in the undefined area, causes an error.

Table 2.2-1 Types of Access Attributes

Area	Attribute	Description
User Memory	Read	Data Read and Instruction Execution Enabled
Emulation Memory	Write	Data Write Enabled
Undefined GUARD	GUARD	Access Disabled
	NOGUARD	No check of access attribute

When access is made to an area without the WRITE attribute by executing a program, a guarded access break occurs after the data has been rewritten if the access target is the user memory area. However, if the access target is the emulation memory area, the break occurs before rewriting. In other words, write-protection (memory data cannot be overwritten by writing) can be set for the emulation memory area by not specifying the WRITE attribute for the area.

This write-protection is only enabled for access made by executing a program, and is not applicable to access by commands.

■ Creating and Displaying Memory Map

Use the following commands for memory mapping.

- SET MAP: Sets memory map
- SHOW MAP: Displays memory map
- CANCEL MAP: Changes memory map setting to undefined

[Example]

```
>SET MAP /USER H'0..H'1FFF
>SET MAP /READ/EMULATION H'FF00..H'FFFF
>SET MAP/GUARD
>SHOW MAP
address        attribute         type
0000 .. 1FFF   code read write   user
FF00 .. FFFF   code read         emulation
-----------------------------------------------------------------
undefined area : guard
setup possibility : user = 19   emulation=19
```

2.2.1.4 Timer Minimum Measurement Unit

The timer minimum measurement unit affects the sequencer, the emulation timer and the performance measurement timer.

■ Setting Timer Minimum Measurement Unit

Choose either 1 μs or 100 ns as the timer minimum measurement unit for the emulator of measuring time.

The minimum measurement unit for the following timers is changed depending on this setup.

- Timer values of sequencer (timer conditions at each level)
- Emulation timer
- Performance measurement timer

Table 2.2-2 shows the minimum measurement time length of each timer when 1 μs or 100 ns is selected as the minimum measurement unit.

When the minimum measurement unit is changed, the measurement values of each timer are cleared as well. The default setting is 1 μs.

Table 2.2-2 Minimum Measurement Time Length of Each Timer

	1 μs selected	100 ns selected
Sequencer timer	About 16 s	About 1.6 s
Emulation timer	About 70 min	About 7 min
Performance measurement timer	About 70 min	About 7 min

Use the following commands to control timers.

- SET TIMERSCALE : Sets minimum measurement unit for timers
- SHOW TIMERSCALE: Displays status of minimum measurement unit setting for timers

[Example]

```
>SET TIMERSCALE/100N
>SHOW TIMERSCALE
Timer scale : 100ns
>
```

2.2.2 On-the-fly Executable Commands

Certain commands can be executed even while executing a program. This is called "on-the-fly" execution.

■ On-the-fly Executable Commands

Certain commands can be executed on-the-fly. If an attempt is made to execute a command that cannot be executed on-the-fly, an error "MCU is busy" occurs. Table 2.2-3 lists major on-the-fly executable functions. For further details, refer to the SOFTUNE Workbench Command Reference Manual.

Meanwhile, on-the-fly execution is enabled only when executing the MCU from the menu or the tool button. On-the-fly commands cannot be executed when executing the GO command, etc., from the command window.

Table 2.2-3 Major Functions Executable in On-the-fly Mode

Function	Restrictions	Major Commands
MCU reset	-	RESET
Displaying MCU execution status	-	SHOW STATUS
Displaying trace data	Enabled only when trace function disabled	SHOW TRACE SHOW MULTITRACE
Enable/Disable trace	-	ENABLE TRACE DISABLE TRACE
Displaying execution time measurement value (Timer)	-	SHOW TIMER
Memory operation (Read/Write)	Emulation memory only operable Read only enabled in mirror area	ENTER EXAMINE COMPARE FILL MOVE DUMP SEARCH MEMORY SHOW MEMORY SET MEMORY
Line assembly, Disassembly	Emulation memory only enabled Mirror area, Disassembly only enabled	ASSEMBLE DISASSEMBLE

2.2.3 On-the-fly Memory Access

While on-the-fly, the area mapped to the emulation memory is Read/Write enabled, but the area mapped to the user memory is Read-only enabled.

■ Read/Write Memory while On-the-fly

The user memory cannot be accessed while on-the-fly (executing MCU). However, the emulation memory can be accessed. (The cycle-steal algorithm eliminates any negative effect on the MCU speed.)

This emulator allows the user to use part of the emulation memory as a mirror area. The mirror area holds a copy of the user memory. Using this mirror area makes the user memory to Read-only enabled function available while on-the-fly.

However, at least one time access must be allowed before the emulation memory with the mirror area setting has the same data as the user memory. The following copy types allow the emulation memory with the mirror area setting to have the same data as the user memory.

- Copying only required portion using memory access commands

  Data in the specified portion can be copied by executing a command that accesses memory. The following commands access memory.

  - Memory operation commands
    SET MEMORY, SHOW MEMORY, EXAMINE, ENTER, COMPARE, FILL, MOVE, SEARCH MEMORY, DUMP, COPY, VERIFY
  - Data load/save commands
    LOAD, SAVE

Figure 2.2-2 Access to Mirror Area while MCU Suspended

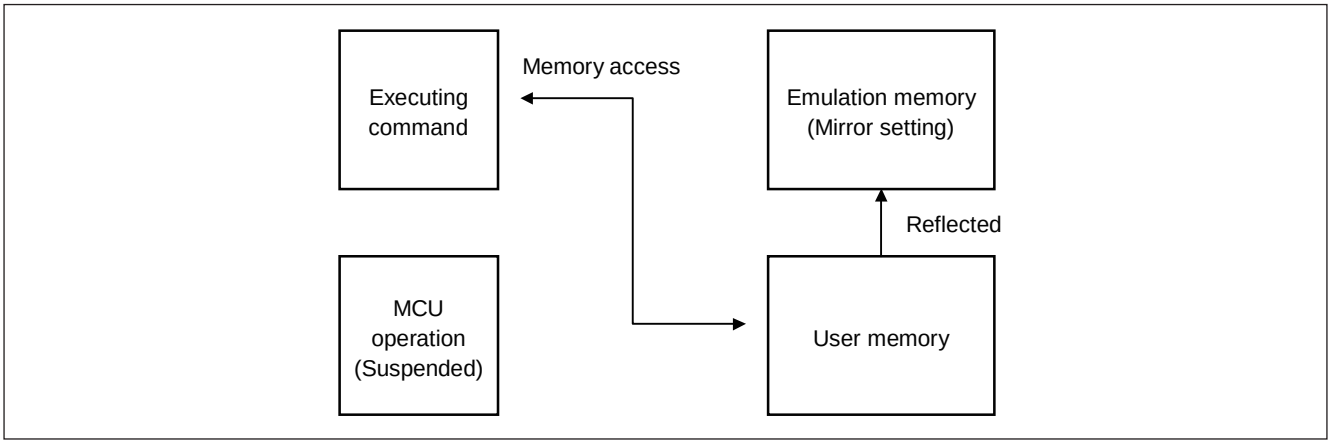
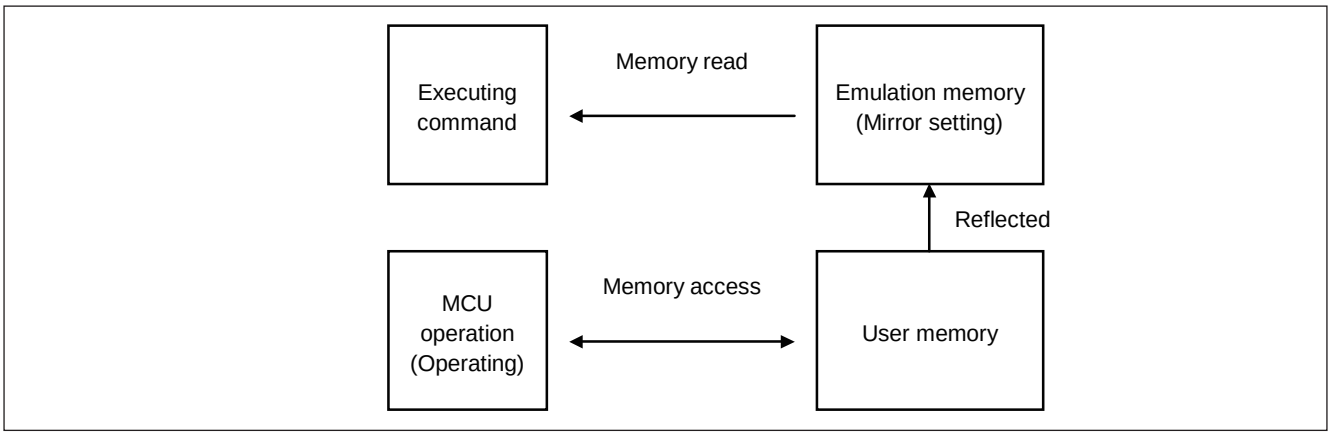


Figure 2.2-3 On-the-fly Access to Mirror Area



Note:

Memory access by a bus master other than the MCU is not reflected in the mirror area.

2.2.4 Break

This Debugger provides seven types of break functions. When by each break function aborts program execution, the address where a break occurred and the break factor are displayed.

■ Break Functions

This Debugger provides the following seven types of break functions;

- Code break
- Data break
- Sequential break
- Guarded access break
- Trace buffer-full break
- Performance buffer-full break
- Forced break

2.2.4.1 Code Break

This function aborts the program execution by monitoring a specified address by software. A break occurs before executing an instruction at the specified address.

■ Code Break

This function aborts the program execution by monitoring a specified address by software. A break occurs before executing an instruction at the specified address.

Up to 65535 addresses can be set for this debugger.

When the code break occurs, the following message appears at the status bar.

Break at address by breakpoint

■ Setting Method

Set code break as follows.

- Command
  - SET BREAK
    Refer to "3.1 SET BREAK (type 1)" of "SOFTUNE Workbench Command Reference Manual".
- Dialog
  - "Code" tab in breakpoint setting dialog
    Refer to "4.6.4 Breakpoint" of "SOFTUNE Workbench Operation Manual".
- Window
  - Source window/disassemble window
    Refer to "3.7 Source Window" or "3.9 Disassemble Window" of "SOFTUNE Workbench Operation Manual".

■ Notes on Instruction Execution Break

If a break point is set after the instruction shown in Figure 2.2-4, a break occurs before the instruction is executed. As the debugger is designed to perform step execution internally and cause a break after the execution, only the last one instruction cannot be executed in real time.

Figure 2.2-4 List of Instructions Affecting Instruction Execution Break

ADDC A,@EP	ADDC A,Ri	ADDC A	ADDCW A
AND A,@EP	AND A,Ri	AND A	ANDW A
CALLV #n	CMP A,@EP	CMP A,Ri	CMP A
CMPW A	DAA	DAS	DEC Ri
DECW A	DECW EP	DECW IX	DECW SP
DIVU A	INC Ri	INCW A	INCW EP
INCW IX	INCW SP	MOV @A,T	MOV @EP,A
MOV A,@A	MOV A,@EP	MOV A,Ri	MOV Ri,A
MOVW @A,T	MOVW A,@A	MOVW A,@EP	MOVW A,EP
MOVW A,IX	MOVW A,PC	MOVW A,PS	MOVW SP,A
MOVW EP,A	MOVW IX,A	MOVW PS,A	MOVW SP,A
MULU A	OR A,@EP	OR A,Ri	OR A
ORW A	POPW A	POPW IX	PUSHW A
PUSHW IX	ROLC A	RORC A	SUBC A,@EP
SUBC A,Ri	SUBC A	SUBCW A	SWAP
XCH A,T	XCHW A,EP	XCHW A,IX	XCHW A,SP
XCHW A,T	XOR A,@EP	XOR A,Ri	XOR A
XORW A			

If an instruction execution break is set following the 1-byte branch instruction shown below, it occurs immediately after the instruction is executed, because the 1-byte branch instruction is affected by prefetch of the next instruction when executed. Instructions when the instruction execution break is set are just prefetched but not executed.

RET	RETI	JMP @A	CALLV #vct

To avoid this, set the instruction execution break shifted one byte or set a breakpoint using the SET EVENT/CODE command, which is unaffected by prefetch.

2.2.4.2 Data Break

It is a function to abort the program execution when the data access (read or write) is done to a specified address.

■ Data Break

This function aborts the program execution when a data access (read/write) is made to a specified address.

Up to 65535 data break points can be set for this debugger.

When the data break occurs, the following message appears at the status bar.

Break at address by databreak at access address

■ Setting Method

Set the data break as follows.

- Command
  - SET DATABREAK
    Refer to "3.10 SET DATABREAK(type 2)" of "SOFTUNE Workbench Command Reference Manual".
- Dialog
  - "Data" tab in breakpoint setting dialog
    Refer to "4.6.4 Breakpoint" of "SOFTUNE Workbench Operation Manual".

2.2.4.3 Sequential Break

A sequential break is a function to abort an executing program, when the sequential condition is met by event sequential control.

■ Sequential Break

A sequential break is a function to abort an executing program, when the sequential condition is met by event sequential control. Use a sequential break when the event mode is set to normal mode using the SET MODE command. When a break occurs due to a sequential break, the following message is displayed on the Status Bar.

Break at Address by sequential break (level = Level No.)

Refer to "2.2.6 Control by Sequencer" for details of the sequential break function.

■ Setting Method

Set the sequential break using the following procedure:

1. Set event mode.
   - Dialog
     - Debug Environment Setting Dialog
       Refer to "4.7.2.3 Debug Environment" of "SOFTUNE Workbench Operation Manual".
   - Command
     - SET MODE
       Refer to "1.4 SET MODE" of "SOFTUNE Workbench Command Reference Manual".
2. Set events
   - Dialog
     - Event Setting Dialog
       Refer to "4.6.5 Event" of "SOFTUNE Workbench Operation Manual".
   - Command
     - SET EVENT
       Refer to "3.15 SET EVENT" of "SOFTUNE Workbench Command Reference Manual".
3. Set sequencer
   - Dialog
     - Sequence Setting Dialog
       Refer to "4.6.6 Sequence" of "SOFTUNE Workbench Operation Manual".
   - Command
     - SET SEQUENCE
       Refer to "3.20 SET SEQUENCE" of "SOFTUNE Workbench Command Reference Manual".

2.2.4.4 Guarded Access Break

A guarded access break aborts an executing program when accessing in violation of the access attribute and accessing a guarded area (undefined area in undefined area).

■ Guarded Access Breaks

A guarded access break aborts an executing program when accessing in violation of the access attribute, and accessing a guarded area (undefined area in undefined area).

A guarded access break occurs in the following cases:

1. Code Guarded

   An instruction has been executed for an area having no code attribute.

2. Read Guarded

   A read has been attempted from the area having no read attribute.

3. Write Guarded

   A write has been attempted to an area having no write attribute.

If a guarded access occurs, the following message is displayed on the Status Bar.

Break at Address by guarded access {code/read/write} at Access Address

■ Setting Method

Set the access attribute as follows.

- Command
  - SET MAP
    Refer to "1.13 SET MAP (type 1)" of "SOFTUNE Workbench Command Reference Manual".
- Dialog
  - MAP Setting Dialog
    Refer to "4.7.3 Memory Map" of "SOFTUNE Workbench Operation Manual".

2.2.4.5 Trace Buffer-full Break

This function aborts the program execution when the trace buffer becomes buffer-full.

■ Trace Buffer-full Break

This function aborts the program execution when the trace buffer becomes buffer-full.

When the trace buffer-full break occurs, the following message appears at the status bar.

Break at address by trace buffer full

■ Setting Method

Set the trace buffer-full break as follows.

- Command
  - SET TRACE/BREAK
    Refer to "4.21 SET TRACE" of "SOFTUNE Workbench Command Reference Manual".
- Dialog
  - Trace setting dialog
    Refer to "4.4.8 Trace" of "SOFTUNE Workbench Operation Manual".

2.2.4.6 Performance Buffer-full Break

It is a function to abort the program execution when the buffer for the performance measurement data storage becomes buffer-full.

■ Performance Buffer-full Break

It is a function to abort the program execution when the buffer for the performance measurement data storage becomes buffer-full.

When the performance buffer-full break occurs, the following message appears at the status bar.

Break at address by performance buffer full

■ Setting Method

Set the performance buffer-full break as follows.

- Command
  - SET PERFORMANCE/BREAK
    Refer to "4.7 SET PERFORMANCE" of "SOFTUNE Workbench Command Reference Manual".
- Dialog
  - Performance setting dialog
    Refer to "4.4.13 Performance" of "SOFTUNE Workbench Operation Manual".

2.2.4.7 Forced Break

This function forcibly aborts the program execution to generate a break.

■ Forced Break

This function forcibly aborts the program execution to generate a break.

When the forced break occurred, the following message appears at the status bar.

Break at address by command abort request

■ Generation Method

The methods of generating forced breaks are as follows.

- Menu
  - [Debug]-[Abort] menu
    Refer to "4.6.2 Abort" of "SOFTUNE Workbench Operation Manual".
- Command
  - ABORT
    Refer to "2.2 ABORT" of "SOFTUNE Workbench Command Reference Manual".

Note:

The forced break cannot be generated when the MCU in the low power consumption mode or in the hold state. If the MCU is in the low power consumption mode or in the hold state when the strong break is requested by the [Debug]-[Abort] menu during the program execution, the [Debug] - [Abort] menu is ignored. To generate a break forcibly, use the [Debug] - [Abort] menu to remove a factor by the user system or use the [Debug]-[Reset of MCU] menu to remove it. If the MCU enters the low power consumption mode or the hold state during the program execution, the condition is displayed at the status bar.

2.2.5 Events

The emulator can monitor the MCU bus operation, and generate a trigger at a specified condition called an event.
In this emulator, event triggers are used in order to determine which function event triggers are used accounting to event modes for the following functions;

- **Sequencer**
- **Sampling condition for multi-trace**
- **Measuring point in performance measurement**

■ Setting Events

Up to eight events can be set.

Table 2.2-4 shows the conditions that can be set for events.

Table 2.2-4 Conditions for Setting Events

Condition	Description
Address	Memory location (Address bit masking enabled)
Data	8-bit data (data bit masking enable) NOT specified enable
Status	Select from among data read, data write, instruction execution and data modify.
External probe	8-bit data (bit masking enable)

Notes:

- In instruction execution, an event trigger is generated only when an instruction is executed. This status cannot be specified concurrently with other status.
- The data modify is a function to generate the event trigger when the data of specified address is rewritten. When the data modify is specified in the status, the specified data is ignored. This status cannot be specified concurrently with other status.

Use the following commands to set an event.

SET EVENT:	Sets event
SHOW EVENT:	Display event setup status
CANCEL EVENT:	Deletes event
ENABLE EVENT:	Enable event
DISABLE EVENT:	Disable event

[Example]

```
>SET EVENT  1,func1
>SET EVENT/WRITE 2,data[2],!d=h'10
>SET EVENT/MODIFY 3,102
```

An event can be set in the Event window as well.

■ Event Modes

There are three event modes as listed below. To determine which function event triggers are used for, select one using the SET MODE command. The default is normal mode.

The event value setting are made for each mode, so switching the event mode changes the event settings as well.

- Normal Mode

  Event triggers are used for sequencer.

  Since the sequencer can perform control at 8 levels, it can control sequential breaks, time measurement and trace sampling. Real-time tracing in the normal mode is performed by single trace (tracing function that samples program execution continuously).

- Multi Trace Mode

  Event triggers are used for multitracing (trace function that samples data before and after event trigger occurrence).

- Performance Mode

  Event triggers are used for performance measurement to measure time duration between two event trigger occurrences and count of event trigger occurrences.

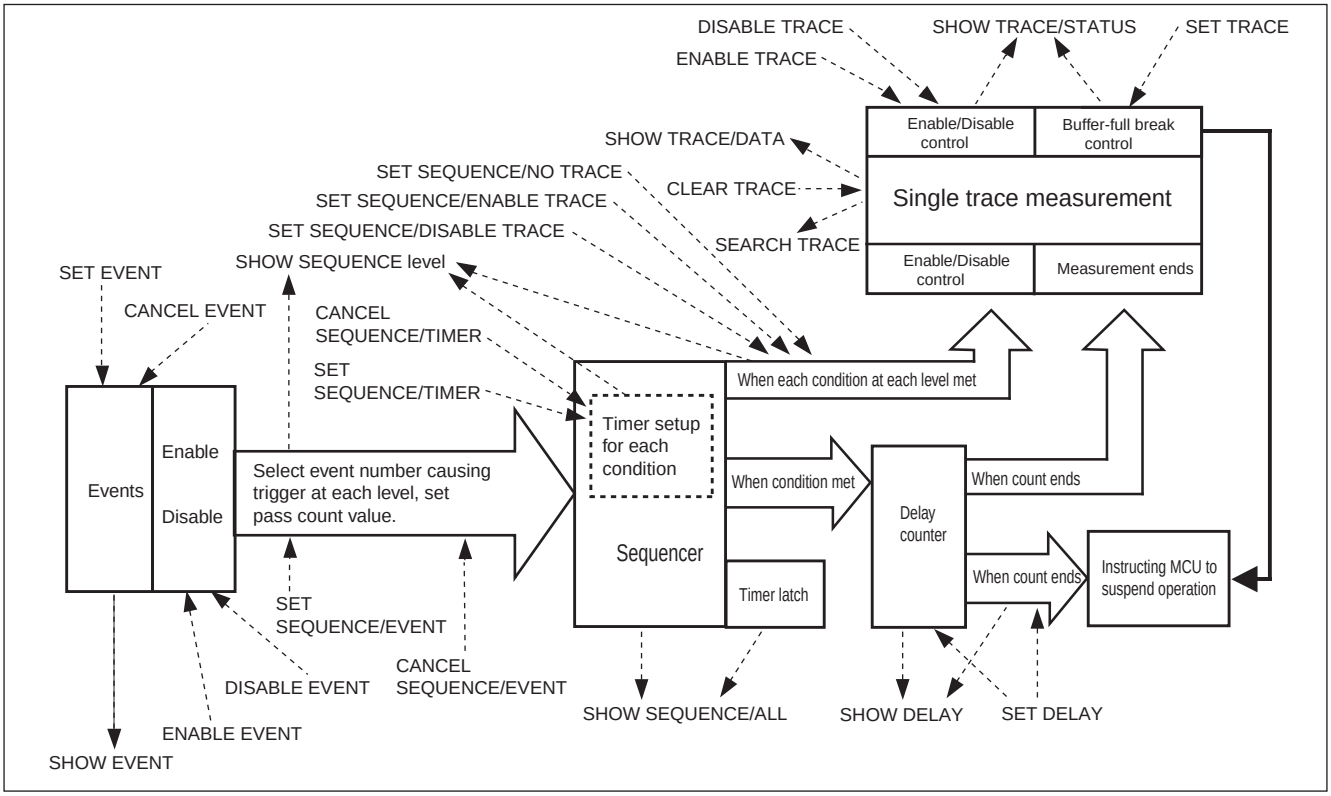
2.2.5.1 Operation in Normal Mode

As shown in the figure below, the event trigger set in the normal mode performs input to the sequencer. In the sequencer, either branching to any level, or terminating the sequencer, can be specified as an operation at event trigger occurrence. This enables debugging (breaks, limiting trace, measuring time) while monitoring program flow.

■ Operation in Normal Mode

The termination of sequencer triggers the delay counter. When the delay counter reaches the specified count, sampling for the single trace terminates. A break normally occurs at this point, but if necessary, the program can be allowed to run on without a break.

Figure 2.2-5 Operation in Normal Mode



■ Event-related Commands in Normal Mode

Since the real-time trace function in the normal mode is actually the single trace function, the commands can be used to control.

Table 2.2-5 shows the event-related commands that can be used in the normal mode.

Table 2.2-5 Event-related Commands in Normal Mode

Mode	Usable Command	Function
Normal Mode	SET EVENT SHOW EVENT CANCEL EVENT ENABLE EVENT DISABLE EVENT	Sets event Displays event setup status Delete event Enables event Disables event
	SET SEQUENCE SHOW SEQUENCE CANCEL SEQUENCE ENABLE SEQUENCE DISABLE SEQUENCE	Sets sequencer Displays sequencer setup status Cancels sequencer Enables sequencer Disables sequencer
	SET DELAY SHOW DELAY	Sets delay count Displays delay count setup status
	SET TRACE SHOW TRACE SEARCH TRACE ENABLE TRACE DISABLE TRACE CLEAR TRACE	Sets trace buffer-full break Displays trace data Searches trace data Enables trace function Disables trace function Clears trace data

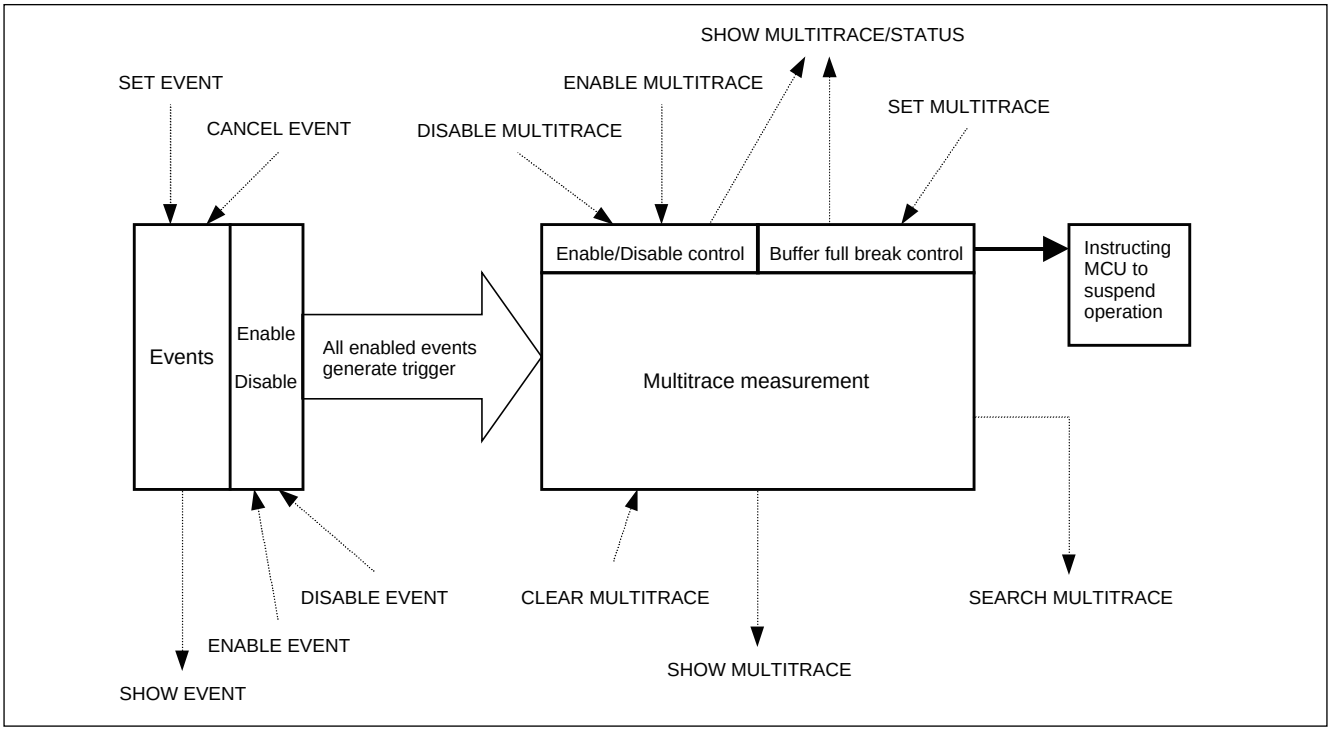
2.2.5.2 Operation in Multi Trace Mode

When the multi trace mode is selected as the event mode, the real-time trace function becomes the multi trace function, and events are used as triggers for multitracing.

■ Operation in Multi Trace Mode

Multitracing is a trace function that samples data before and after an event trigger occurrence. When the multi trace mode is selected as the event mode, the real-time trace function becomes the multi trace function, and events are used as triggers for multitracing.

Figure 2.2-6 Operation in Multi Trace Mode



■ Event-related Commands in Multi Trace Mode

Table 2.2-6 shows the event-related commands that can be used in the multitrace mode.

Table 2.2-6 Event-related Commands in Multi Trace Mode

Mode	Usable Command	Function
Multi Trace Mode	SET EVENT	Sets event
	SHOW EVENT	Displays event setup status
	CANCEL EVENT	Deletes event
	ENABLE EVENT	Enables event
	DISABLE EVENT	Disables event
	SET MULTITRACE	Sets trace buffer-full break
	SHOW MULTITRACE	Displays trace data
	SEARCH MULTITRACE	Searches trace data
	ENABLE MULTITRACE	Enables trace function
	DISABLE MULTITRACE	Disables trace function
	CLEAR MULTITRACE	Clears trace data

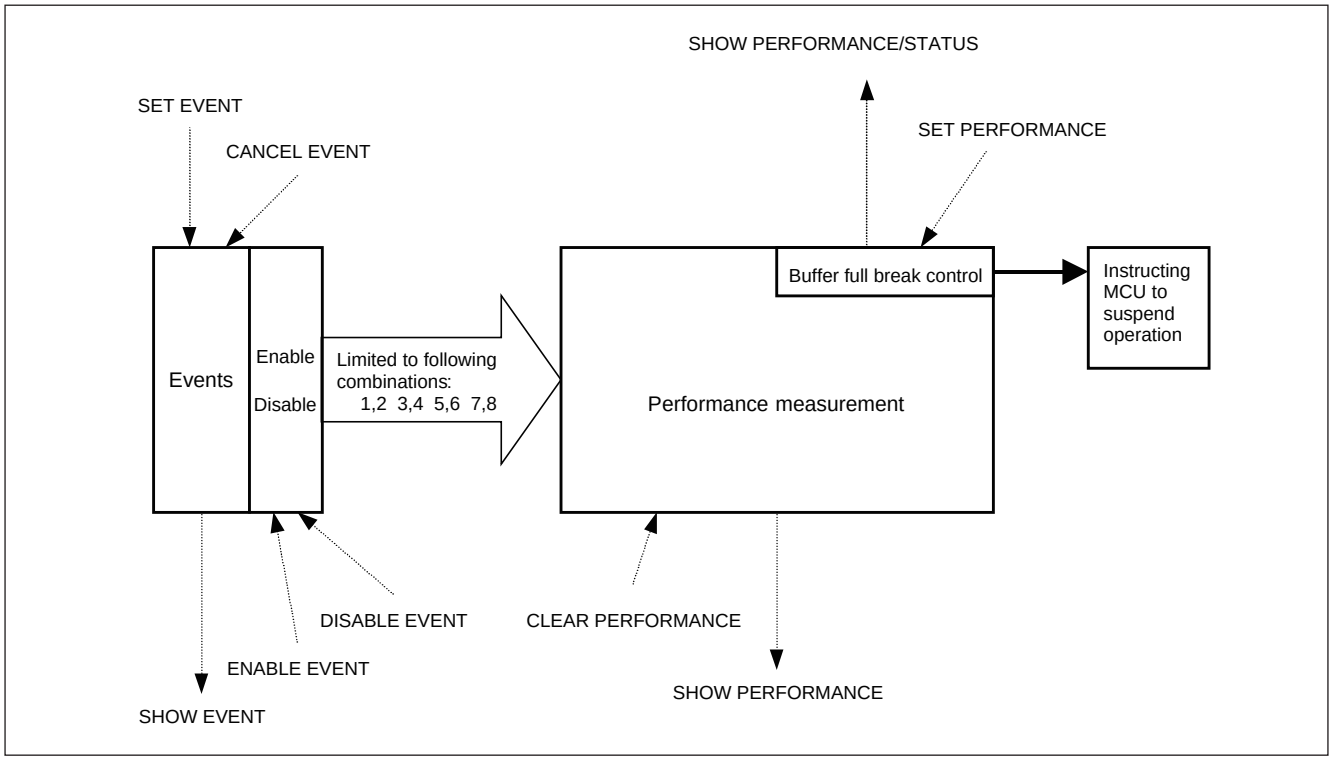
2.2.5.3 Operation in Performance Mode

Event triggers set in the performance mode are used to measure performance. The time duration between two event occurrences can be measured and the event occurrences can be counted.

■ Operation in Performance Mode

The event triggers that are set in the performance mode are used to measure performance. The time duration between two event occurrences can be measured and the event occurrences can be counted.

Figure 2.2-7 Operation in Performance Mode



■ Event-related Commands in Performance Mode

Table 2.2-7 shows the event-related commands that can be used in the performance mode.

Table 2.2-7 Event-related Commands in Performance Mode

Mode	Usable Command	Function
Performance Mode	SET EVENT SHOW EVENT CANCEL EVENT ENABLE EVENT DISABLE EVENT	Sets event Displays event setup status Deletes event Enables event Disables event
	SET PERFORMANCE SHOW PERFORMANCE CLEAR PERFORMANCE	Sets performance Displays performance setup status Clears performance measurement data

2.2.6 Control by Sequencer

This function aborts program execution when a program passes through a specified event based on a specific sequence under conditions of the event.

■ Sequence Function

This function aborts program execution when a program passes through a specified event based on a specific sequence under conditions of the event. A break generated by this function is referred to as a sequential break.

This function enables time measurement or sampling control as well as a break.

■ Use Conditions

To use the sequence function, set the event mode to the normal mode.

For details about setting, refer to one of the following.

"1.4 SET MODE" of "SOFTUNE Workbench Command Reference Manual"

"4.7.2.3 Debug Preferences" of "SOFTUNE Workbench Operation Manual"

■ Control by Sequencer

As shown in Table 2.2-8, controls can be made at 8 different levels.

At each level, 8 events and 1 timer condition (9 conditions in total) can be set.

A timer condition is met when the timer count starts at entering a given level and the specified time is reached.

For each condition, the next operation can be specified when the condition is met. Select any one of the following.

- Move to required level.
- Terminate sequencer.

The conditions set for each level are determined by OR. Therefore, if any one condition is met, the sequencer either moves to the required level, or terminates. In addition, trace sampling suspend/resume can be controlled when a condition is met.

Table 2.2-8 Sequencer Specifications

Function	Specifications
Level count	8 levels
Conditions settable for each level	8 event conditions (1 to 16777216 times pass count can be specified for each condition.) 1 timer condition (Up to 16 s. in 1μs unit or up to 1.6 s. in 100 ns units can be specified.*)
Operation when condition met	Branches to required level or terminates sequencer. Controls trace sampling.
Other function	Timer latch enable at level branching
Operation when sequencer terminates	Starts delay counter.

*: The minimum measurement unit for Timer value can be set to either 1 μs or 100 ns using the SET TIMERSCALE command.

2.2.6.1 Setting Sequencer

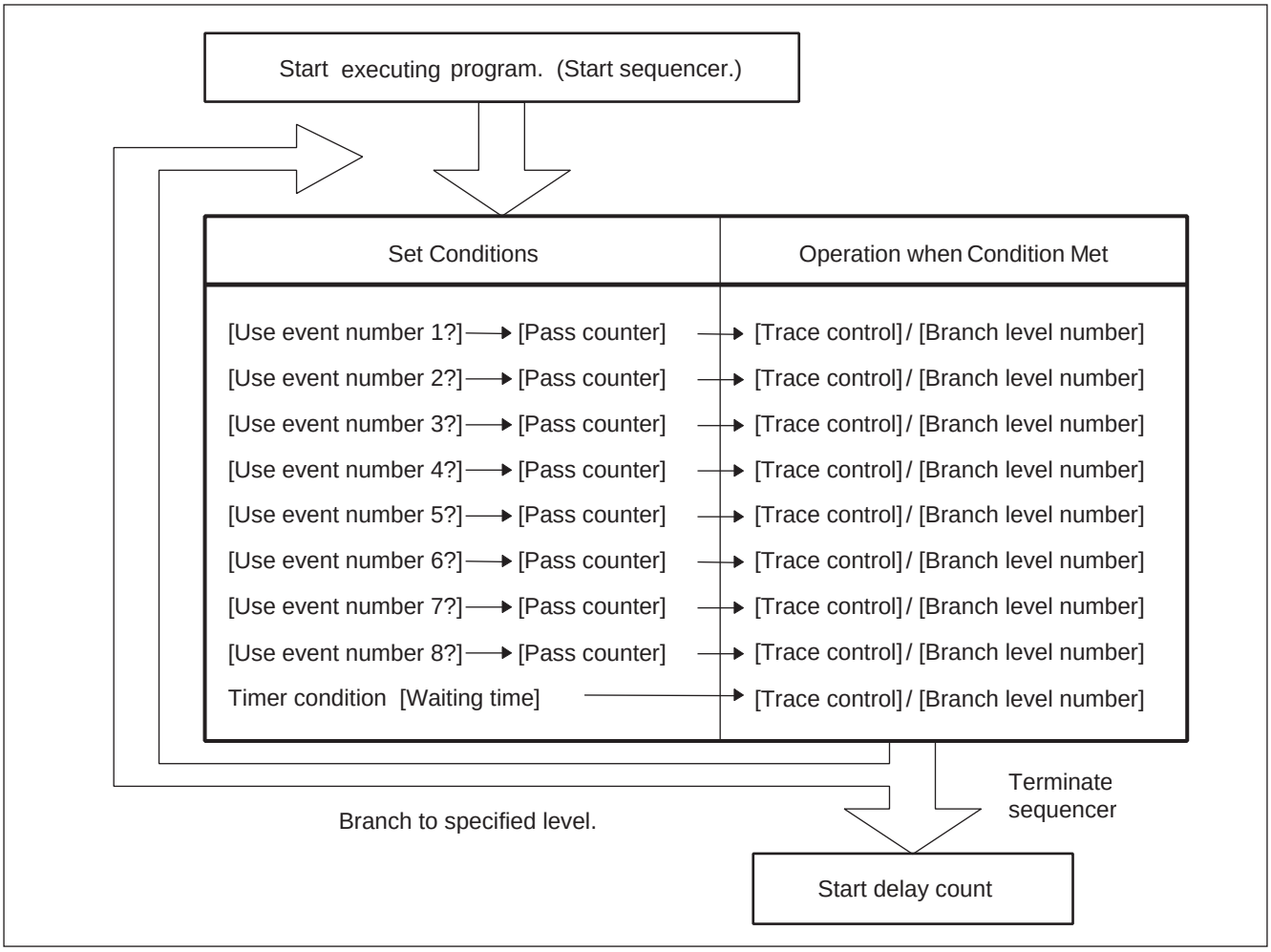
The sequencer operates in the following order:

1. **The sequencer starts from level 1 simultaneously with the start of program executing.**
2. **Depending on the setting at each level, branching to the required level is performed when the condition is met.**
3. **When sequencer termination is specified, the sequencer terminates when the condition is met.**
4. **When the sequencer terminates, the delay counter starts counting.**

■ Setting Sequencer

Figure 2.2-8 shows the sequencer operation.

Figure 2.2-8 Operation of Sequencer


Start executing program. (Start sequencer.)
Set Conditions
Operation when Condition Met
[Use event number 1?] → [Pass counter] → [Trace control] / [Branch level number]
[Use event number 2?] → [Pass counter] → [Trace control] / [Branch level number]
[Use event number 3?] → [Pass counter] → [Trace control] / [Branch level number]
[Use event number 4?] → [Pass counter] → [Trace control] / [Branch level number]
[Use event number 5?] → [Pass counter] → [Trace control] / [Branch level number]
[Use event number 6?] → [Pass counter] → [Trace control] / [Branch level number]
[Use event number 7?] → [Pass counter] → [Trace control] / [Branch level number]
[Use event number 8?] → [Pass counter] → [Trace control] / [Branch level number]
Timer condition [Waiting time] → [Trace control] / [Branch level number]
Terminate sequencer
Branch to specified level.
Start delay count

[Setup Examples]

- Terminate sequencer when event 1 occurs.

```
>SET SEQUENCE/EVENT 1,1,J=0
```

- Terminate sequencer when event 2 occurs 16 times.

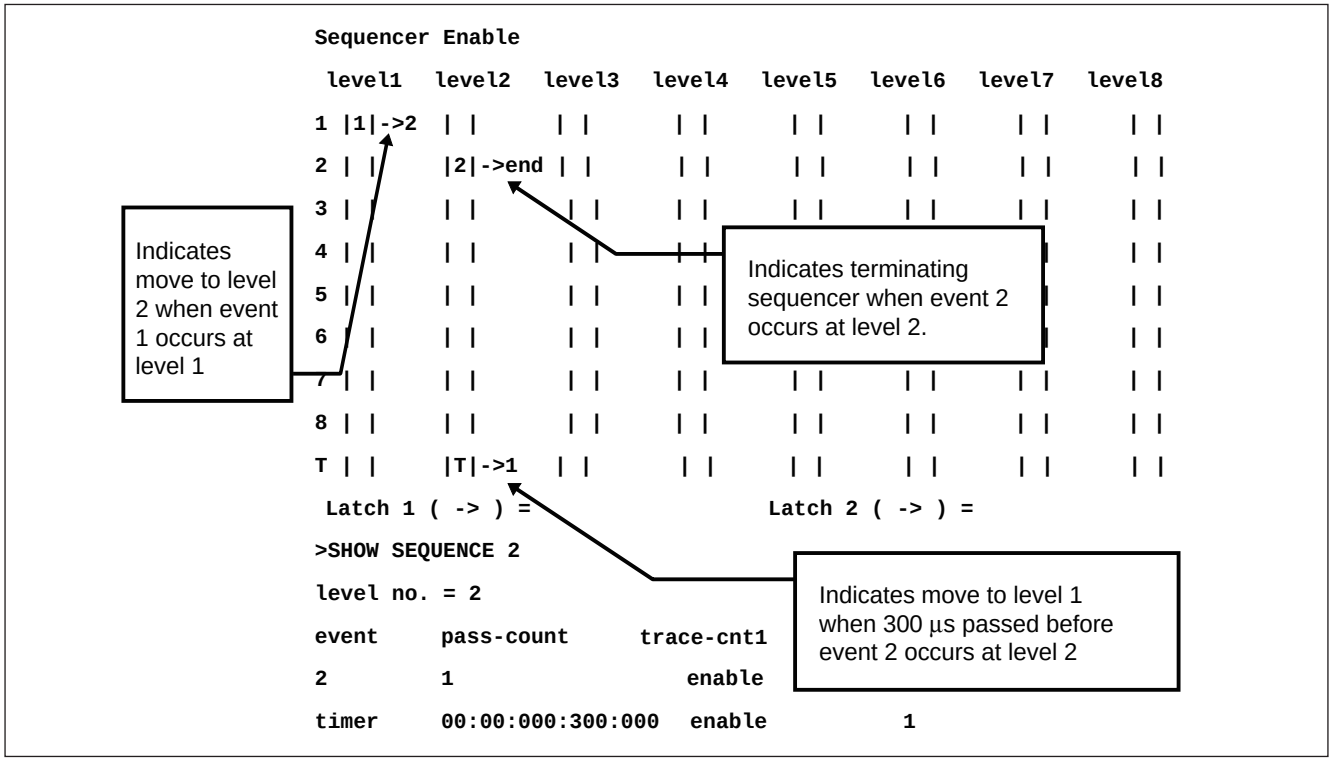
```
>SET SEQUENCE/EVENT 1,2,16,J=0
```

- Terminate sequencer when event 2 occurs after event 1 occurred. However, do not terminate sequencer if event 3 occurs between event 1 and event 2.

```
>SET SEQUENCE/EVENT 1,1,J=2
>SET SEQUENCE/EVENT 2,2,J=0
>SET SEQUENCE/EVENT 2,3,J=1
```

- Terminate sequencer when event 2 occurs less than 300 μs after event 1 occurred.

```
>SET SEQUENCE/EVENT 1,1,J=2
>SET SEQUENCE/EVENT 2,2,J=0
>SET SEQUENCE/TIMER 2,300,J=1
>SHOW SEQUENCE
```


Sequencer Enable
level1 level2 level3 level4 level5 level6 level7 level8
1 |1|->2
2 |2|->end
T |T|->1
Latch 1 (->) =
Latch 2 (->) =
>SHOW SEQUENCE 2
level no. = 2
event pass-count trace-cnt1
2 1 enable
timer 00:00:000:300:000 enable 1
Indicates move to level 2 when event 1 occurs at level 1
Indicates terminating sequencer when event 2 occurs at level 2.
Indicates move to level 1 when 300 μs passed before event 2 occurs at level 2

2.2.6.2 Break by Sequencer

A program can aborts program execution when the sequencer terminates. This break is called a sequential break.

■ Break by Sequencer

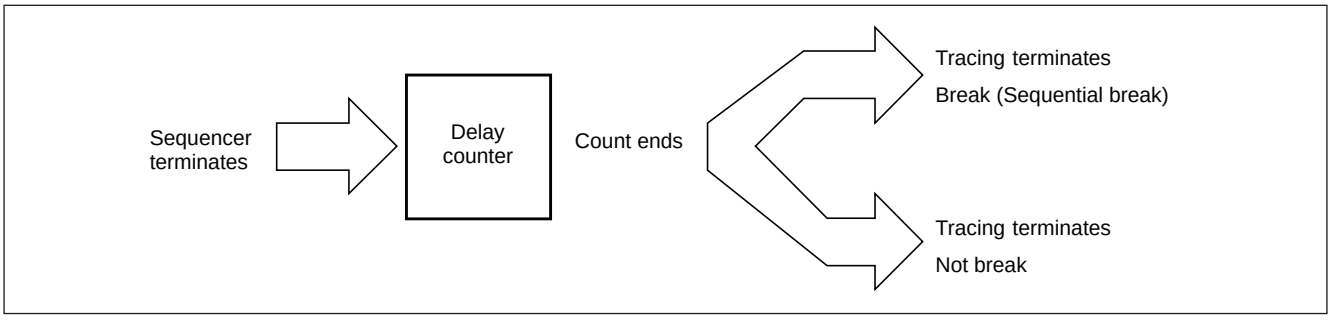
A program can aborts program execution when the sequencer terminates. This break is called a sequential break.

As shown in Figure 2.2-9, the delay count starts when the sequencer terminates, and after delay count ends, either "break" or "not break but tracing only terminates" is selected as the next operation.

To make a break immediately after the sequencer terminates, set delay count to 0 and specify "Break after delay count terminates". Use the SET DELAY command to set the delay count and the operation after the delay count.

The default is delay count 0, and Break after delay count.

Figure 2.2-9 Operation when sequencer terminates



[Examples of Delay Count Setups]

- Break when sequencer terminates.

```
>SET DELAY/BREAK 0
```

- Break when 100-bus-cycle tracing done after sequencer terminates.

```
>SET DELAY/BREAK 100
```

- Terminate tracing, but do not break when sequencer terminates.

```
>SET DELAY/NOBREAK 0
```

- Terminate tracing, but do not break when 100-bus-cycle tracing done after sequencer terminates.

```
>SET DELAY/NOBREAK 100
```

2.2.6.3 Trace Sampling Control by Sequencer

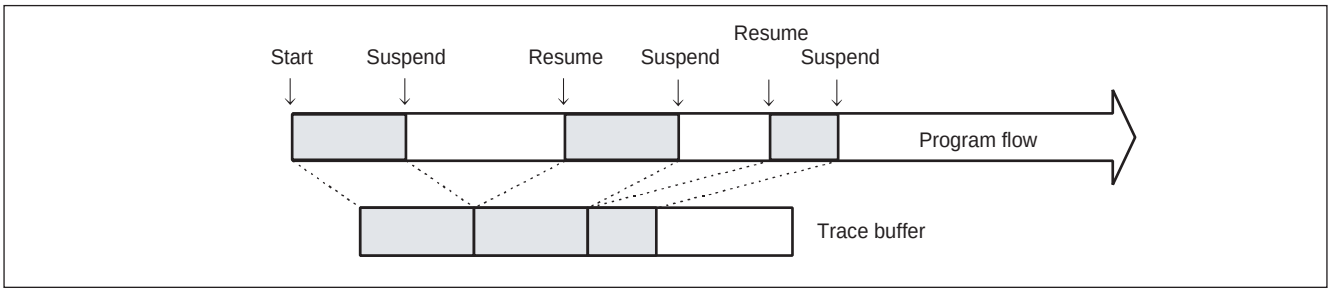
When the event mode is in the normal mode, real-time trace executing tracing called single trace.
If the trace function is enabled, single trace samples all the data from the start of executing a program until the program is suspended.

■ Trace Sampling Control by Sequencer

Sets up suspend/resume trace sampling for each condition at each level of the sequencer. Figure 2.2-10 shows the trace sampling flow.

For example, it is possible to suspend trace sampling when event 1 occurs, and then resume trace sampling when event 2 occurs. Sampling trace data can be restricted.

Figure 2.2-10 Trace Sampling Control (1)

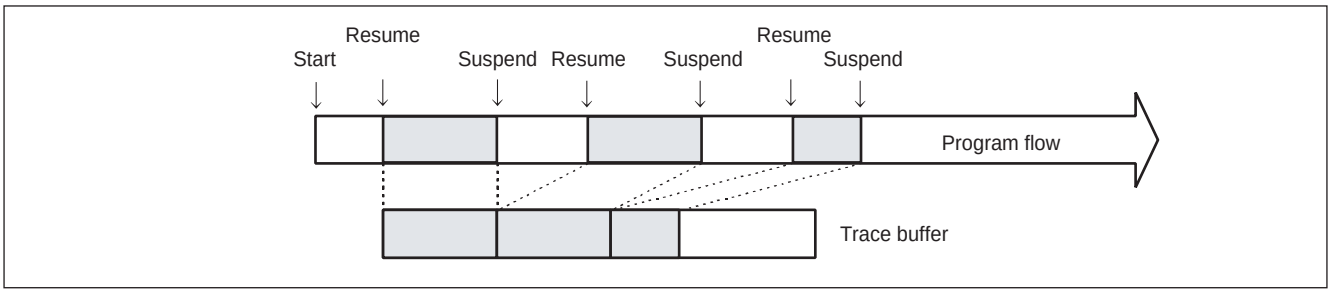


As shown in Figure 2.2-11, trace sampling can be disabled during the period from the start of a program execution until the first condition occurs. For this setup, use the GO command or the SET GO command.

[Example]

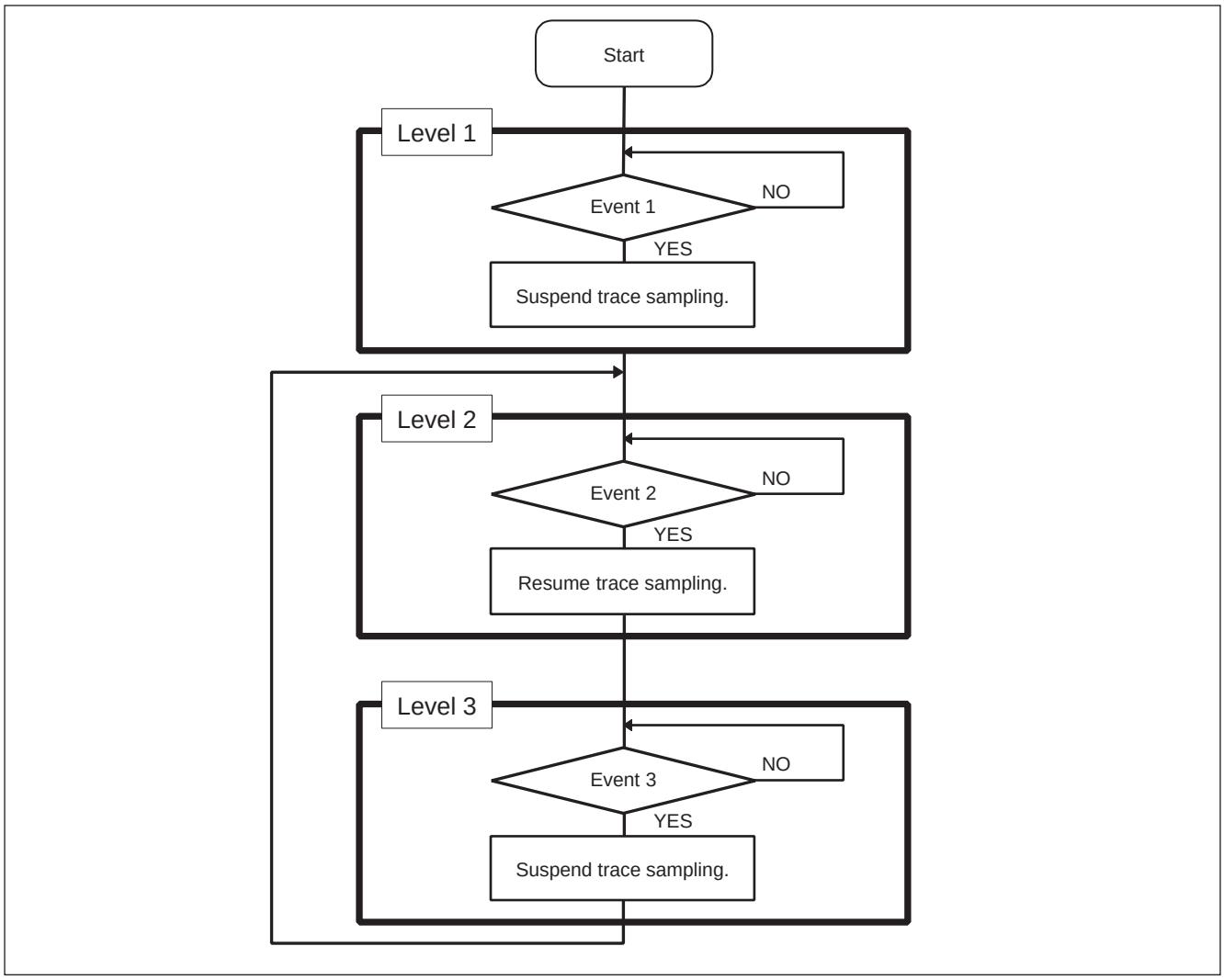
```
>GO/DISABLETRACE
>SET GO/DISABLETRACE
>GO
```

Figure 2.2-11 Trace Sampling Control (2)



[Setup Example]

Suspend trace sampling when event 1 occurs, and then resume at event 2 and keep sampling data until event 3 occurs.




```
>SET SEQUENCE/EVENT/DISABLETRACE 1,1,J=2
>SET SEQUENCE/EVENT/ENABLETRACE 2,2,J=3
>SET SEQUENCE/EVENT/DISABLETRACE 3,3,J=2
```

2.2.6.4 Time Measurement by Sequencer

Time can be measured using the sequencer. A time measurement timer called the emulation timer is used for this purpose. When branching is made from a specified level to another specified level, a timer value is fetched. Up to two emulation timer values can be fetched. This function is called the timer latch function.

■ Time Measurement by Sequencer

The time duration between two given points in a complex program flow can be measured using the timer latch function.

The timing for the timer latch can be set using the SET SEQUENCE command; the latched timer values can be displayed using the SHOW SEQUENCE command.

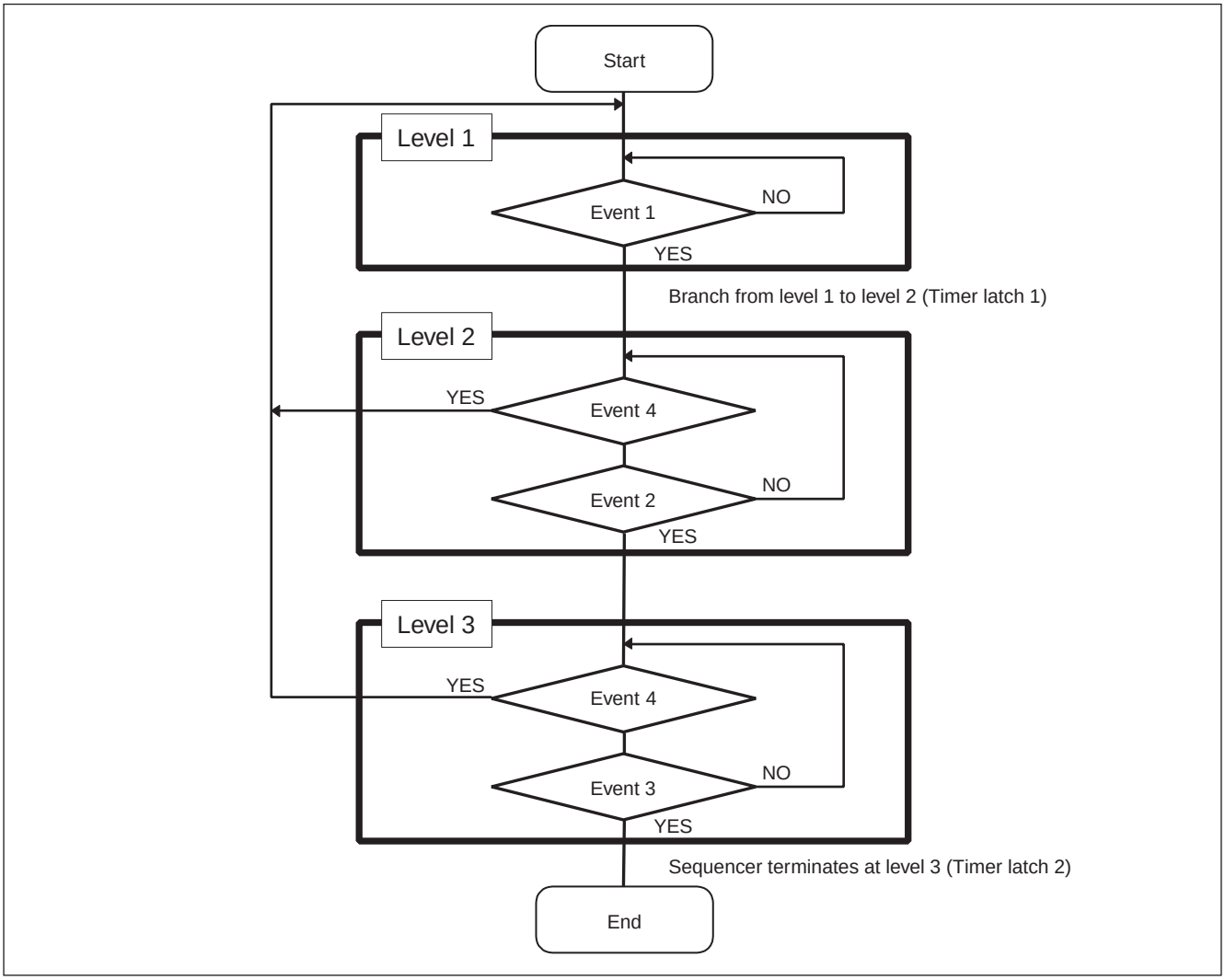
When a program starts execution, the emulation timer is initialized and then starts counting. Select either 1μs or 100 ns as the minimum measurement unit for the emulation timer. Set the measurement unit using the SET TIMERSCALE command.

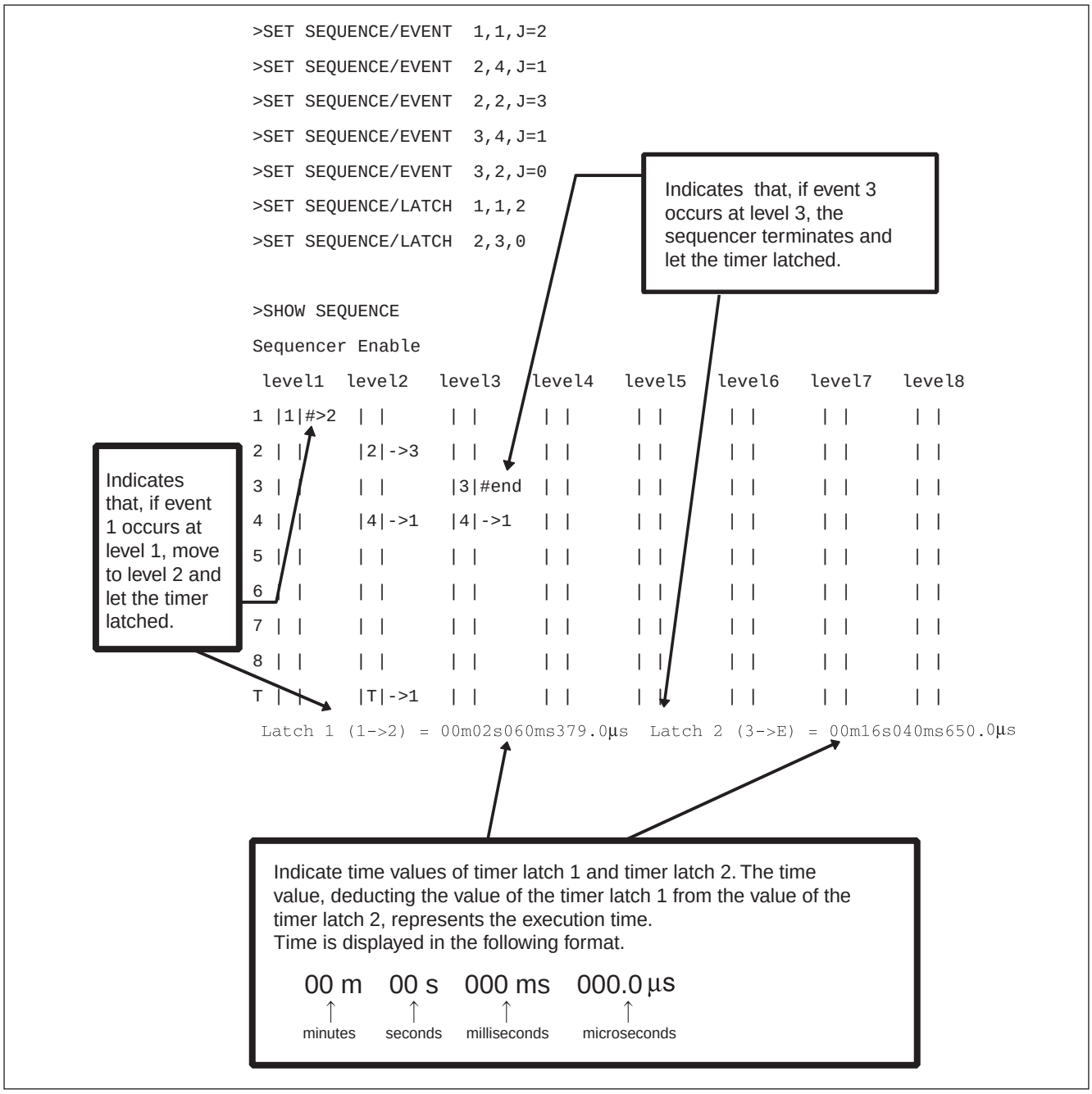
When 1 μs is selected, the maximum measured time is about 70 minutes; when 100 ns is selected, the maximum measured time is about 7 minutes. If the timer overflows during measurement, a warning message is displayed when the timer value is displayed using the SHOW SEQUENCE command.

2.2.6.5 Sample Flow of Time Measurement by Sequencer

In the following sample, when events are executed in the order of Event 1, Event 2 and Event 3, the execution time from the Event 1 to the Event 3 is measured. However, no measurement is made if Event 4 occurs anywhere between Event 1 and Event 3.

■ Sample Flow of Time Measurement by Sequencer




>SET SEQUENCE/EVENT 1,1,J=2
>SET SEQUENCE/EVENT 2,4,J=1
>SET SEQUENCE/EVENT 2,2,J=3
>SET SEQUENCE/EVENT 3,4,J=1
>SET SEQUENCE/EVENT 3,2,J=0
>SET SEQUENCE/LATCH 1,1,2
>SET SEQUENCE/LATCH 2,3,0
>SHOW SEQUENCE
Sequencer Enable
level1 level2 level3 level4 level5 level6 level7 level8
1 |1|#>2 | | | | | | | | | | | | | |
2 | | |2|->3 | | | | | | | | | | | |
3 | | | | |3|#end | | | | | | | | | |
4 | | |4|->1 |4|->1 | | | | | | | | | |
5 | | | | | | | | | | | | | | | |
6 | | | | | | | | | | | | | | | |
7 | | | | | | | | | | | | | | | |
8 | | | | | | | | | | | | | | | |
T | | |T|->1 | | | | | | | | | | | |
Latch 1 (1->2) = 00m02s060ms379.0µs Latch 2 (3->E) = 00m16s040ms650.0µs
Indicates that, if event 3 occurs at level 3, the sequencer terminates and let the timer latched.
Indicates that, if event 1 occurs at level 1, move to level 2 and let the timer latched.
Indicate time values of timer latch 1 and timer latch 2. The time value, deducting the value of the timer latch 1 from the value of the timer latch 2, represents the execution time.
Time is displayed in the following format.
00 m 00 s 000 ms 000.0 µs
minutes
seconds
milliseconds
microseconds

2.2.7 To Refer to a Program Execution History, Use [TRACE]

This section describes the real-time trace function of this emulator debugger.

■ Real-time Trace Function

Trace is a function that records program execution record.

Trace data includes the following information that can be used to analyze the program execution record.

- The record of programs executed (address)
- Data accessed while executing programs (specified attributes only)
- Status information
  Access status: read / write / internal access
  Device status: Instruction execution / reset / hold
- External probe data
- Sequencer execution level

■ Trace Mode

There are two trace methods prepared.

- Single trace: traces from the beginning to the end of program execution
- Multi trace: traces when events occur

■ Trace Buffer

Trace buffer is a location where recorded data is stored.

A single data unit stored in the trace buffer is called a frame.

The trace buffer can contain up to 32,768 (32K) frames.

Trace buffer is a ring buffer; when it becomes buffer-full, the new record automatically replaces the oldest record in the buffer.

2.2.7.1 Single Trace

The single trace function traces all data from the start of executing a program until the program is aborted.

■ Function of Single Trace

The single trace is enabled by setting the event mode to normal mode using the SET MODE command.

The single trace function traces all data from the start of executing a program until the program is suspended.

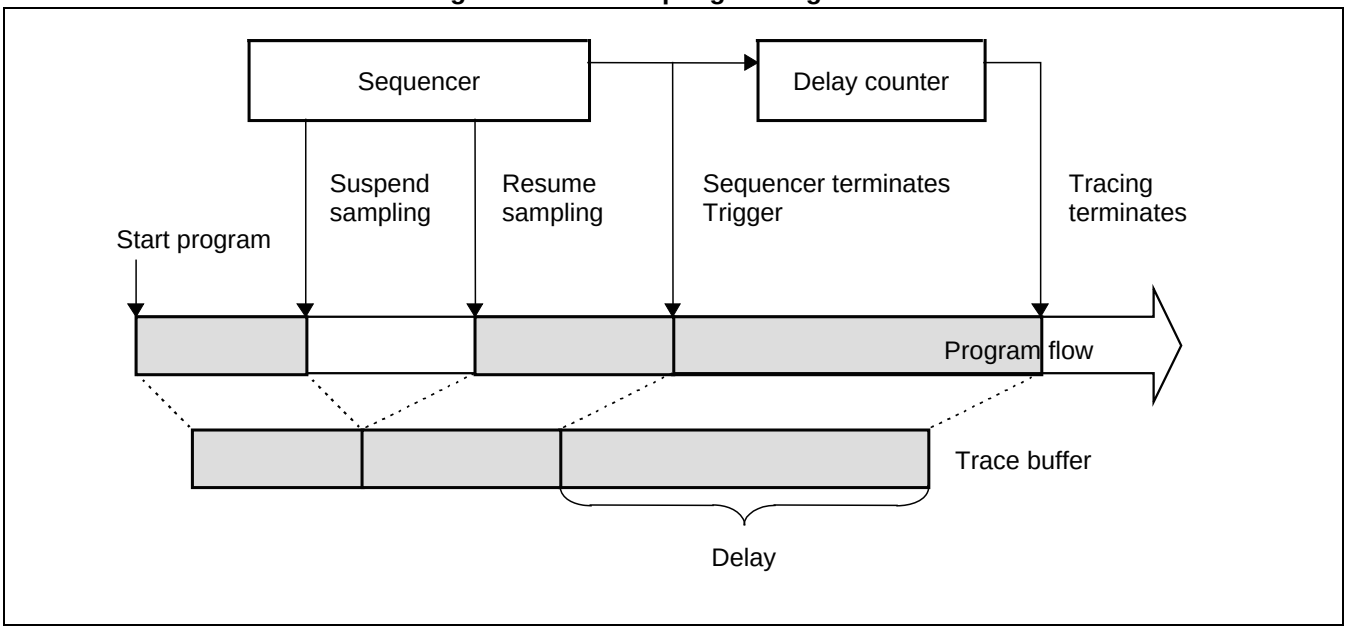
If the real-time trace function is enabled, data sampling continues execution to record the data in the trace buffer while the GO, STEP, CALL commands are being executed.

As shown in Figure 2.2-12, suspend/resume trace sampling can be controlled by the event sequencer. Since the delay can be set between the sequencer terminating the trigger and the end of tracing, the program flow after an given event occurrence can be traced. The delay count is counted in bus cycle units, so it matches the sampled trace data count. However, nothing can be sampled during the delay count if trace sampling is suspended when the sequencer is terminated.

After the delay count ends, a break occurs normally due to the sequential break, but tracing can be terminated without a break.

Furthermore, a program can be allowed to break when the trace buffer becomes buffer-full. This break is called a trace-buffer-full break.

Figure 2.2-12 Sampling in Single Trace



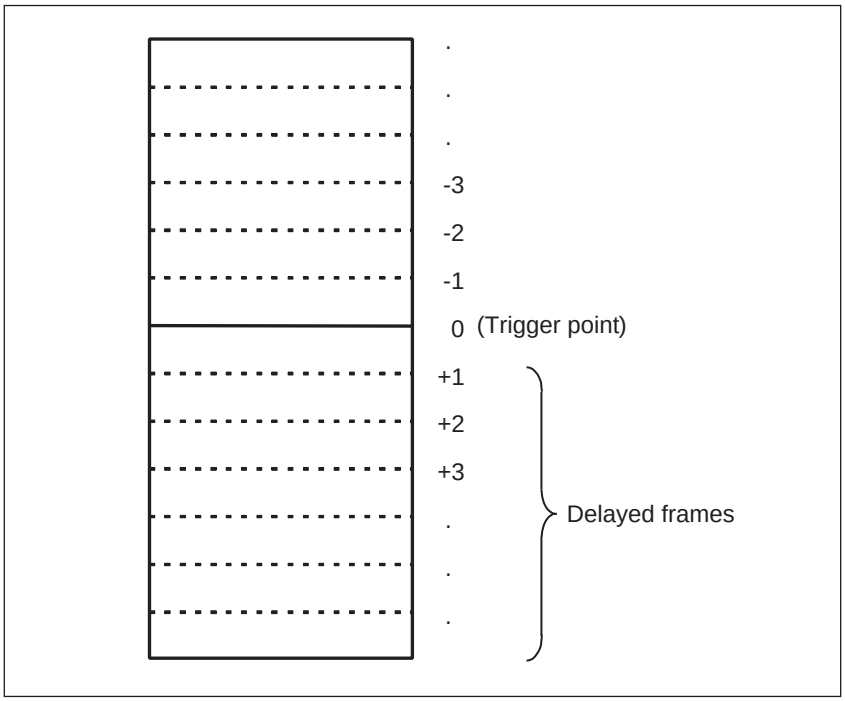
■ Frame Number and Step Number in Single Trace

The sampled trace data is numbered in frame units. This number is called the frame number.

When displaying trace data, the starting location in the trace buffer can be specified using the frame number. The trace data at the point where the sequencer termination trigger occurs is numbered 0; trace data sampled before reaching the trigger point is numbered negatively, and the data sampled after the trigger point is numbered positively (See Figure 2.2-13).

If there is no sequencer termination trigger point available, the trace data sampled last is numbered 0.

Figure 2.2-13 Frame Number in Single Trace



2.2.7.2 Setting Single Trace

The following settings 1 to 4 are required before executing single trace. Once these settings have been made, trace data is sampled when a program is executed.

1. Set event mode to normal mode.
2. Enable trace function.
3. Set events, sequencer, and delay count.
4. Set trace-buffer-full break.

■ Setting Single Trace

The following settings are required before executing single trace. Once these settings have been made, trace data is sampled when a program is executed.

1. Set event mode to normal mode.

   Use SET MODE command to make this setting.

2. Enable trace function.

   Use the ENABLE TRACE command. To disable the function, use the DISABLE TRACE command. The default is Enable.

3. Set events, sequencer, and delay count.

   Trace sampling can be controlled by setting the sequencer for events. If this function is not needed, there is no need of this setting.

   To set events, use the SET EVENT command. To set the sequencer, use the SET SEQUENCE command.

   Furthermore, set the delay count between sequencer termination and trace ending, and the break operation (Break or Not Break) when the delay count ends. If the data after event occurrence is not required, there is no need of this setting.

   If Not Break is set, the trace terminates but no break occurs. To check trace data in on-the-fly, use this setup by executing the SET DELAY command.

4. Set trace-buffer-full break.

   The program can be allowed to break when the trace buffer becomes buffer-full. Use the SET TRACE command for this setting. The default is Not Break. Display the setup status using the SHOW TRACE/ STATUS command.

   Table 2.2-9 lists trace-related commands that can be used in the single trace function.

Table 2.2-9 Trace-related Commands that can be used in the single trace function

Usable Command	Function
SET EVENT	Sets events
SHOW EVENT	Displays event setup status
CANCEL EVENT	Deletes event
ENABLE EVENT	Enables event
DISABLE EVENT	Disables event
SET SEQUENCE	Sets sequencer
SHOW SEQUENCE	Displays sequencer setting status
CANCEL SEQUENCE	Cancels sequencer
ENABLE SEQUENCE	Enables sequencer
DISABLE SEQUENCE	Disables sequencer
SET DELAY	Sets delay count value and operation after delay
SHOW DELAY	Displays delay count setting status
SET TRACE	Sets traces-buffer-full break
SHOW TRACE	Displays trace data
SEARCH TRACE	Searches trace data
ENABLE TRACE	Enables trace function
DISABLE TRACE	Disables trace function
CLEAR TRACE	Clears trace data

Note:

When the sequencer termination causes a break (sequential break), the last executed machine cycle is not sampled.

2.2.7.3 Multi Trace

The multi trace function samples data where an event trigger occurs for 8 frames before and after the event trigger.

■ Multi Trace Function

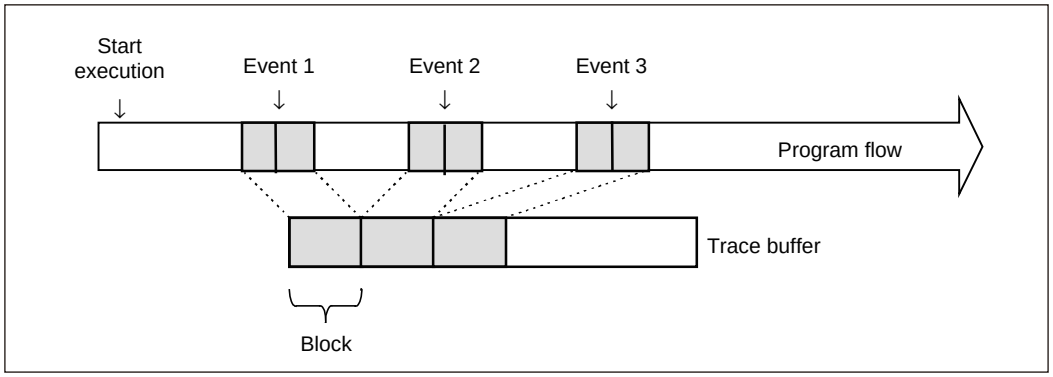
Execute multi trace by setting the event mode to the multi trace mode using the SET MODE command.

The multi trace function samples data where an event trigger occurs for 8 frames before and after the event trigger.

It can be used for tracing required only when a certain variable access occurs, instead of continuous tracing.

The trace data sampled at one event trigger (16 frames) is called a block. Since the trace buffer can hold 32K frames, up to 2048 blocks can be sampled. Multi trace sampling terminates when the trace buffer becomes buffer-full. At this point, a executing program can be allowed to break if necessary.

Figure 2.2-14 Multi Trace Sampling



■ Multi Trace Frame Number

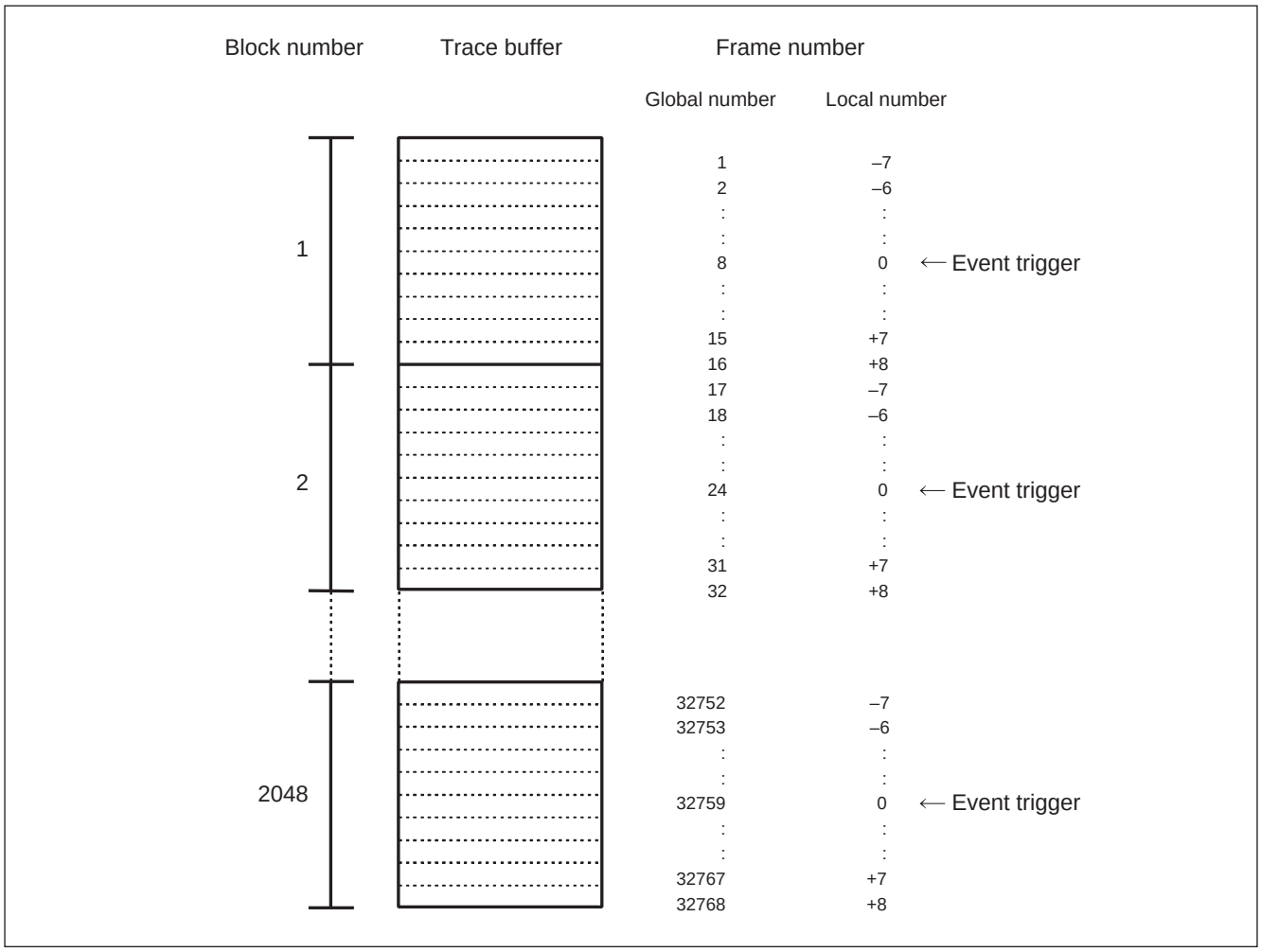
Sixteen frames of data are sampled each time an event occurs. This data unit is called a block, and each sampled block is numbered starting from 0. This is called the block number.

A block is a collection of 8 frames of sampled data before and after the event trigger occurs. At the event trigger point is 0, trace data sampled before reaching the event trigger point is numbered negatively, and trace data sampled after the event trigger point is numbered positively. These frame numbers are called local numbers (See Figure 2.2-15).

In addition to this local number, there is another set of frame numbers starting with the oldest data in the trace buffer. This is called the global number. Since the trace buffer can hold 32K frames, frames are numbered 1 to 32768 (See Figure 2.2-15).

To specify which frame data is displayed, use the global number or block and local numbers.

Figure 2.2-15 Frame Number in Multi Trace



2.2.7.4 Setting Multi Trace

Before executing the multi trace function, the following settings must be made. After these settings, trace data is sampled when a program is executed.
1. Set event mode to multi trace mode.
2. Enable trace function.
3. Set event.
4. Set trace-buffer-full break.

■ Setting Multi Trace

Before executing the multi trace function, the following settings must be made. After these settings, trace data is sampled when a program is executed.

1. Set event mode to multi trace mode.

   Use the SET MODE command for this setting.

2. Enable trace function.

   Use the ENABLE MULTITRACE command. To disable the function, use the DISABLE MULTITRACE command.

3. Set event.

   Set an event that sampling. Use the SET EVENT command for this setting.

4. Set trace-buffer-full break.

   To break when the trace buffer becomes buffer-full, set the trace-buffer-full break. Use the SET MULTITRACE command for this setting.

Table 2.2-10 shows the list of trace-related commands that can be used in multi trace mode.

Table 2.2-10 Trace-related Commands that can be used in multi trace mode

Usable Command	Function
SET EVENT	Sets events
SHOW EVENT	Displays event setup status
CANCEL EVENT	Deletes event
ENABLE EVENT	Enables event
DISABLE EVENT	Disables event
SET MULTITRACE	Sets trace-buffer-full break
SHOW MULTITRACE	Displays trace data
SEARCH MULTITRACE	Searches trace data
ENABLE MULTITRACE	Enables multi trace
DISABLE MULTITRACE	Disables multi trace
CLEAR MULTITRACE	Clears trace data

2.2.7.5 Displaying Trace Data Storage Status

It is possible to display how much trace data is stored in the trace buffer. This status data can be read by specifying /STATUS to the SHOW TRACE command in the single trace mode and to the SHOW MULTITRACE command in the multi trace mode.

■ Displaying Trace Data Storage Status

It is possible to display how much trace data is stored in the trace buffer. This status data can be read by specifying /STATUS to the SHOW TRACE command in the single trace mode and to the SHOW MULTITRACE command in the multi trace mode.

Frame numbers displayed in the multi trace mode is the global number.

[Example]

- In Single Trace

```
 >SHOW TRACE/STATUS
en/dis      = enable        :Trace function enabled
buffer full = nobreak       :Buffer full break function disabled
sampling    = end           :Trace sampling terminates
frame no. = -00120 to 00050 :Frame -120 to 50 store data
step no.  = -00091 to 00022 :Step -91 to 22 store data
 >
```

- In Multi Trace

```
 >SHOW MULTITRACE/STATUS
en/dis      = enable        :Multi trace function enabled
buffer full = nobreak       :Buffer full break function disabled
sampling    = end           :Trace sampling terminates
block no. = 1 to 5          :Block 1 to 5 store data
frame no. = 00001 to 00159  :Frame 1 to 159 store data
                             (Global number)
```

2.2.7.6 Specify Displaying Trace Data Position

It is possible to specify from which data in the trace buffer to display. To do so, specify a frame number with the SHOW TRACE command in the single trace mode, or specify either a global number or a block number and local number with the SHOW MULTITRACE command in the multi trace mode. A range can also be specified.

■ Specify Displaying Trace Data Position

It is possible to specify from which data in the trace buffer to displays. To do this, specify a step or frame number with the SHOW TRACE command in the single trace, and specify either a global number or a block number and local number with the SHOW MULTITRACE command in the multi trace mode. A range can also be specified.

[Example]

- In Single Trace Mode

```
>SHOW TRACE -6              Start displaying from frame -6
>SHOW TRACE -6..10          Display from frame -6 to frame 10
```

- In Multi Trace

```
>SHOW MULTITRACE/GLOBAL 500     Start displaying from frame 500
                                (Global number)
>SHOW MULTITRACE/LOCAL 2        Displaying block number 2
>SHOW MULTITRACE/LOCAL 2,-5..5  Display from frame -5 to frame 5
                                of block number 2
```

2.2.7.7 Display Format of Trace Data

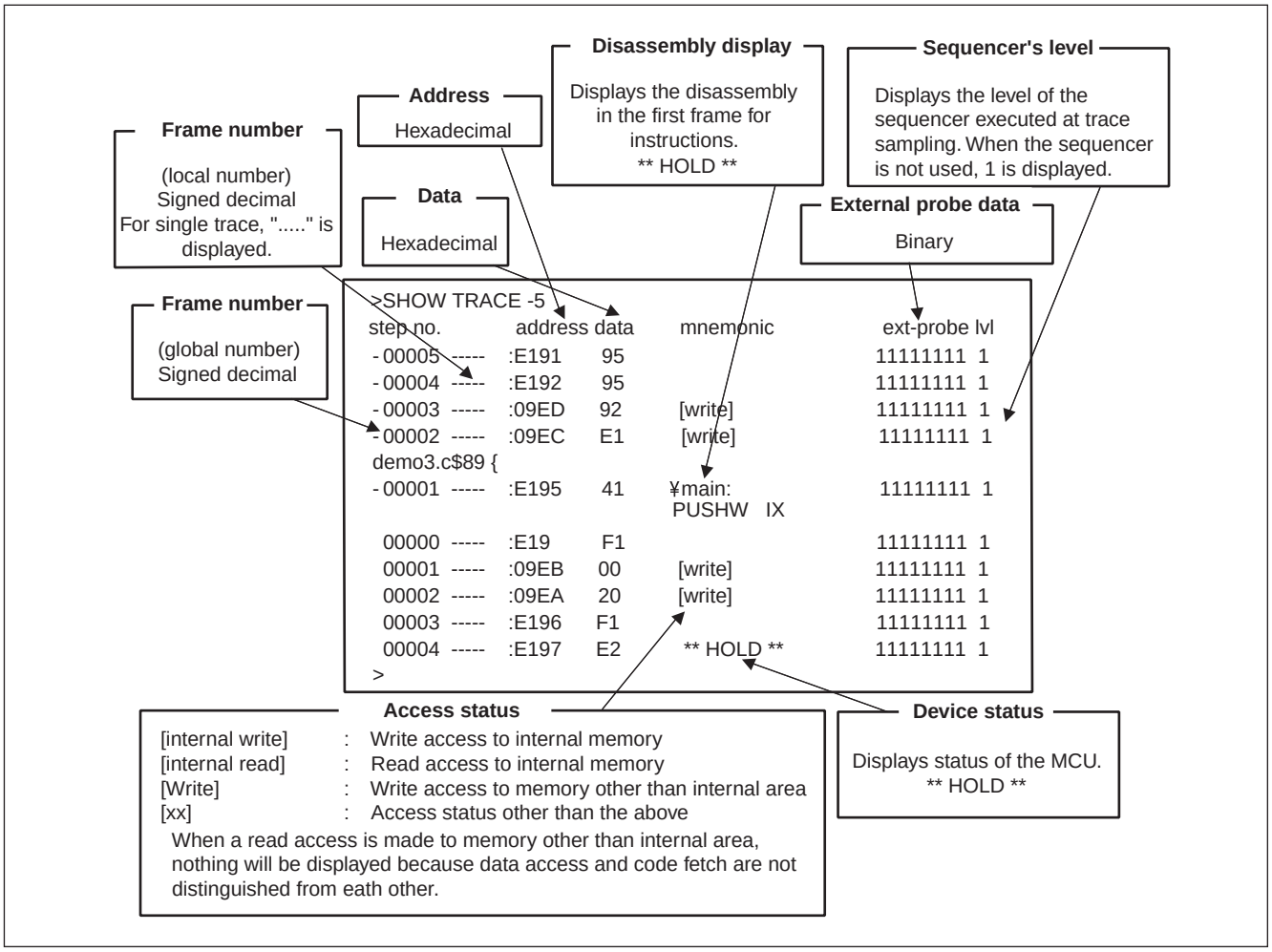
A display format can be chosen by specifying a command identifier with the SHOW TRACE command in the single trace, and with the SHOW MULTITRACE command in the multi trace. The source line is also displayed if "Add source line" is selected using the SET SOURCE command.

There are three formats to display trace data:

- **Display in all bus cycles (Specify /CYCLE.)**
- **Display in only instruction execution (Specify /INSTRUCTION.)**
- **Display in source line units (Specify /SOURCE.)**

■ Display All Bus Cycles (Specify /CYCLE.)

In this mode, data can be displayed in the following format.


Disassembly display
Displays the disassembly in the first frame for instructions.
** HOLD **
Sequencer's level
Displays the level of the sequencer executed at trace sampling. When the sequencer is not used, 1 is displayed.
Address
Hexadecimal
Frame number
(local number)
Signed decimal
For single trace, "....." is displayed.
Data
Hexadecimal
External probe data
Binary
Frame number
(global number)
Signed decimal
>SHOW TRACE -5
step no. address data mnemonic ext-probe lvl
- 00005 ----- :E191 95 11111111 1
- 00004 ----- :E192 95 11111111 1
- 00003 ----- :09ED 92 [write] 11111111 1
- 00002 ----- :09EC E1 [write] 11111111 1
demo3.c$89 {
- 00001 ----- :E195 41 ¥main: 11111111 1
PUSHW IX
00000 ----- :E19 F1 11111111 1
00001 ----- :09EB 00 [write] 11111111 1
00002 ----- :09EA 20 [write] 11111111 1
00003 ----- :E196 F1 11111111 1
00004 ----- :E197 E2 ** HOLD ** 11111111 1
>
Access status
[internal write] : Write access to internal memory
[internal read] : Read access to internal memory
[Write] : Write access to memory other than internal area
[xx] : Access status other than the above
When a read access is made to memory other than internal area, nothing will be displayed because data access and code fetch are not distinguished from eath other.
Device status
Displays status of the MCU.
** HOLD **

For multi trace, "Block number = XXXXXX" is displayed at the beginning of a block.

■ Display in Only Instruction Execution (Specify /INSTRUCTION.)

Only instruction execution is displayed in the same format as when /CYCLE is specified.

Data, access status, and device status are not displayed.

[Example]

```
>SHOW TRACE/INSTRUCTION -5
frame no.         address     mnemonic            ext-probe   lvl
demo3.c$89 {
-00001      ----- :E195       \main:              11111111    1
                              PUSHW     IX
 00003      ----- :E196       MOVW      A,SP      11111111    1
 00005      ----- :E197       MOVW      IX,A      11111111    1
 00007      ----- :E198       PUSHW     A         11111111    1
 00011      ----- :E199       PUSHW     A         11111111    1
 00015      ----- :E19A       PUSHW     A         11111111    1
demo3.c$91           int cc = 1;
 00019      ----- :E19B       MOVW      A,#0001   11111111    1
 00022      ----- :E19E       MOVW      @IX-02,A  11111111    1
demo3.c$93           numdt = 10;
 00027      ----- :E1A0       MOVW      A,#000A   11111111    1
>
```

■ Display in Source Line Units (Specify /SOURCE.)

Only the source line can be displayed.

[Example]

```
 >SHOW TRACE/SOURCE -5
frame no.        source
-00001:    ----- :    demo3.c$89{
 00019:    ----- :    demo3.c$91    int cc  =  1;
 00027:    ----- :    demo3.c$93    numdt = 10;
 00035:    ----- :    demo3.c$94    ackdat = 0;
 00041:    ----- :    demo3.c$96    sort (&datpl); /* data sorting */
 00054:    ----- ;    demo3.c$147   struct st *dat;
 00071:    ----- :    demo3.c$152   ackdat += 5;
 00082:    ----- :    demo3.c$153   nckdat = ackdat;
 00086:    ----- :    demo3.c$154   for (j=0 ; j<numdt-1; j++) {
>
```

2.2.7.8 Reading Trace Data On-the-fly

Trace data can be read while executing a program. However, this is not possible during sampling. Disable the trace function or terminate tracing before attempting to read trace data.

■ Reading Trace Data On-the-fly in Single Trace

To disable the trace function, use the DISABLE TRACE command. Check whether or not the trace function is currently enabled by executing the SHOW TRACE command with /STATUS specified, or by using built-in variable, %TRCSTAT.

Tracing terminates when the delay count ends after the sequencer has terminated. If Not Break is specified here, tracing terminates without a break operation. It is possible to check whether or not tracing has terminated by executing the SHOW TRACE command with /STATUS specified, or by using built-in variable, %TRCSAMP.

To read trace data, use the SHOW TRACE command; to search trace data, use the SEARCH TRACE command. Use the SET DELAY command to set the delay count and break operation after the delay count.

[Example]

```
>GO
>>SHOW TRACE/STATUS
en/dis       = enable
buffer full  = nobreak
sampling     = on          <- Trace sampling continues.
>>SHOW TRACE/STATUS
en/dis       = enable
buffer full  = nobreak
sampling     = end         <- Trace sampling ends.
frame no.    = -00805 to 00000
step no.     = -00262 to 00000
>>SHOW TRACE -10
frame no.    address   data   mnemonic     ext-probe    lvl
-00010_ _ _ _: F000    04     MOV  A,#55   11111111     1
-00009_ _ _ _: F001    55                  11111111     1
-00008_ _ _ _: F002    45     MOV  60,A    11111111     1
-00007_ _ _ _: F003    60                  11111111     1
.            .         .
```

If the CLEAR TRACE command is executed with the trace ending state, trace data sampling can be re-executed by re-executing the sequencer from the beginning.

■ Reading Trace Data On-the-fly in the Multi Trace

Use the DISABLE MULTITRACE command to disable the trace function before reading trace data. Check whether or not the trace function is currently enabled by executing the SHOW MULTITRACE command with /STATUS specified, or by using built-in variable %TRCSTAT.

To read trace data, use the SHOW MULTITRACE command; to search trace data, use the SEARCH MULTITRACE command.

[Example]

```
 >GO
>>SHOW MULTITRACE/STATUS
en/dis       = enable
buffer full  = nobreak
sampling     = on
>>DISABLE MULTITRACE
>>SHOW MULTITRACE/STATUS
en/dis       = disable
buffer full  = nobreak
sampling     = end
block no.    = 1 to 20
frameno.     = 00001 to 00639
>>SHOW MULTITRACE  1
frame no.      address    data    mnemonic      ext-probe   lvl
block no. = 1
00001 -00007 : F000       04      MOV  A,#55    11111111    1
00002 -00006 : F001       55                    11111111    1
00003 -00005 : F002       45      MOV  60,A     11111111    1
00004 -00004 : F003       60                    11111111    1
                    .                   .                 .
                    .                   .                 .
```

2.2.7.9 Saving Trace Data

This section explains the methods to save trace data.

■ Saving Trace Data

Trace data can be saved into a specified file.

Both GUI (via window or dialog) and command-only methods can be used. These methods produce the same results.

- Saving via GUI
  1. Display the trace window.
     - Select [Display] - [Trace] in the menu.
  2. Specify a file name to which the trace data will be saved.
     - Right-click on the trace window, and select [save] in the pop-up menu. "Save As..." dialog is displayed.
       Here, specify the file name and directory to where you wish to store the file.
       Refer to section "4.4.8 Trace" of "SOFTUNE Workbench Operation Manual" for detailed information.

- Saving via command
  Save the trace data.
     - Execute SHOW TRACE/FILE command.
       Refer to section "4.22 SHOW TRACE (type 1)" of "SOFTUNE Workbench Command Reference Manual" for detailed information.
       To append and save data to an existing file, execute SHOW TRACE/FILE/APPEND command.

2.2.7.10 Searching of Trace Data

This section explains the methods to search trace data.

■ Searching of Trace Data

This function searches for trace data with a specified address or frame number.

Both GUI (via window or dialog) and command-only methods can be used. These methods give the same results.

- Searching via GUI
  1. Display the trace window.
     - Select [Display] -[Trace] in the menu.
  2. Specify the address or the frame number that you wish to search.
     - Right-click on the trace window, and select [search] in the pop-up menu. Trace search dialog is displayed.
       Here, specify the address or the frame number that you wish to be displayed. Refer to section "4.4.8 Trace" of "SOFTUNE Workbench Operation Manual" for detailed information.

- Searching via command
  Search the trace data.
     - Execute SEARCH TRACE command.
       Refer to section "4.23 SEARCH TRACE" of "SOFTUNE Workbench Command Reference Manual" for detailed information.

2.2.8 Measuring Performance

It is possible to measure the time and pass count between two events. Repetitive measurement can be performed while executing a program in real-time, and when done, the data can be totaled and displayed.
Using this function enables the performance of a program to be measured. To measure performance, set the event mode to the performance mode using the SET MODE command.

■ Performance Measurement Function

The performance measurement function allows the time between two event occurrences to be measured and the number of event occurrences to be counted. Up to 32767 event occurrences can be measured.

- Measuring Time

  Measures time interval between two events.

  Events can be set at 8 points (1 to 8). However, in the performance measurement mode, the intervals, starting event number and ending event number are combined as follows. Four intervals have the following fixed event number combination:

Interval	Starting Event Number	Ending Event Number
1	1	2
2	3	4
3	5	6
4	7	8

- Measuring Count

  The specified events become performance measurement points automatically, and occurrences of that particular event are counted.

2.2.8.1 Performance Measurement Procedures

Performance can be measured by the following procedure:

- **Setting event mode.**
- **Setting minimum measurement unit for timer.**
- **Specify performance-buffer-full break.**
- **Setting events.**
- **Execute program.**
- **Display measurement result.**
- **Clear measurement result.**

■ Setting Event Mode

Set the event mode to the performance mode using the SET MODE command. This enables the performance measurement function.

[Example]

```
>SET MODE/PERFORMANCE
>
```

■ Setting Minimum Measurement Unit for Timer

Using the SET TIMERSCALE command, choose either 1 μs or 100 ns as the minimum measurement unit for the timer used to measure performance. The default is 1 μs.

When the minimum measurement unit is changed, the performance measurement values are cleared.

[Example]

```
>SET TIMERSCALE/1U   <- Set 1 ms as minimum unit.
>
```

■ Specify Performance-Buffer-Full Break

When the buffer for storing performance measurement data becomes buffer-full, a executing program can be broken. This function is called the performance-buffer-full break. The performance buffer becomes buffer-full when an event occurs 32767 times.

If the performance-buffer-full break is not specified, the performance measurement ends, but the program does not break.

[Example]

```
>SET PERFORMANCE/NOBREAK   <- Specifying Not Break
>
```

■ Setting Events

Set events using the SET EVENT command.

The starting/ending point of time measurement and points to measure pass count are specified by events.

Events at 8 points (1 to 8) can be set. However, in the performance measurement, the intervals, starting event number and ending event number are fixed in the following combination.

- Measuring Time

  Four intervals have the following fixed event number combination.

Interval	Starting Event Number	Ending Event Number
1	1	2
2	3	4
3	5	6
4	7	8

- Measuring Count

  The specified events become performance measurement points automatically.

■ Executing Program

Start measuring when executing a program by using the GO or CALL command. If a break occurs during interval time measurement, the data for this specific interval is discarded.

■ Displaying Performance Measurement Data

Display performance measurement data by using the SHOW PERFORMANCE command.

■ Clearing Performance Measurement Data

Clear performance measurement data by using the CLEAR PERFORMANCE command.

[Example]

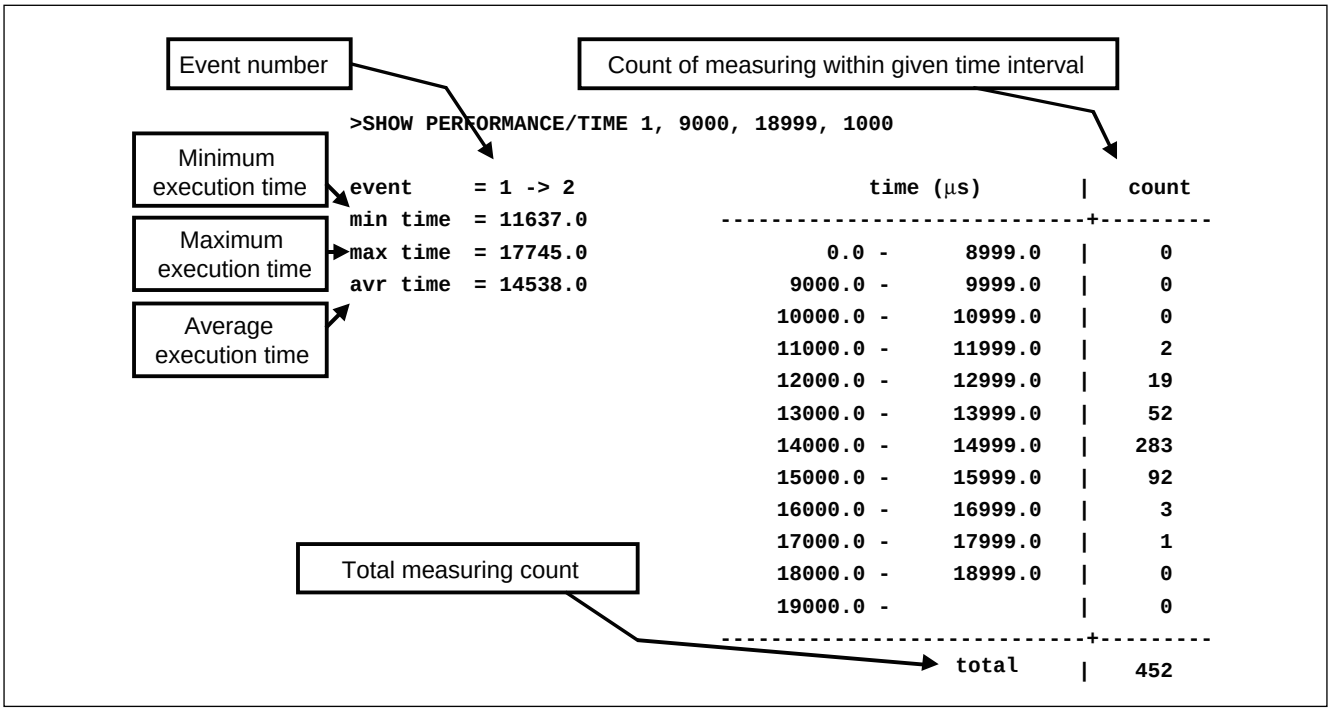
```
>CLEAR PERFORMANCE
>
```

2.2.8.2 Display Performance Measurement Data

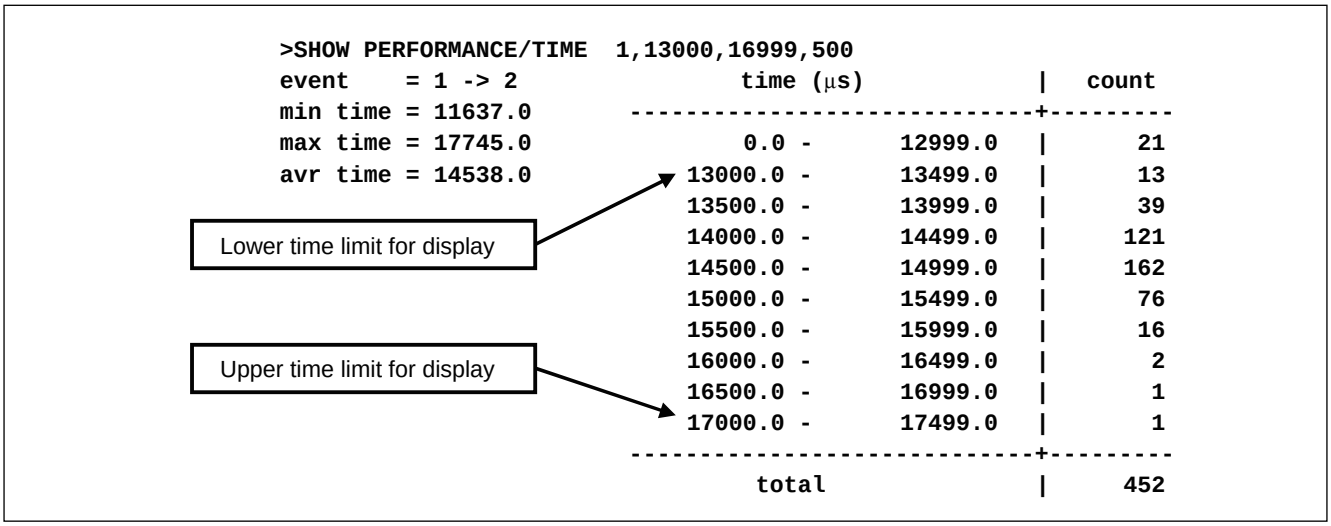
Display the measured time and measuring count by using the SHOW PERFORMANCE command.

■ Displaying Measured Time

To display the time measured, specify the starting event number or the ending event number.


Event number
Count of measuring within given time interval
Minimum execution time
Maximum execution time
Average execution time
Total measuring count
>SHOW PERFORMANCE/TIME 1, 9000, 18999, 1000
event = 1 -> 2
min time = 11637.0
max time = 17745.0
avr time = 14538.0
time (μs) | count
0.0 - 8999.0 | 0
9000.0 - 9999.0 | 0
10000.0 - 10999.0 | 0
11000.0 - 11999.0 | 2
12000.0 - 12999.0 | 19
13000.0 - 13999.0 | 52
14000.0 - 14999.0 | 283
15000.0 - 15999.0 | 92
16000.0 - 16999.0 | 3
17000.0 - 17999.0 | 1
18000.0 - 18999.0 | 0
19000.0 - | 0
total | 452

The lower time limit, upper time limit and display interval can be specified. The specified time value is in 1μs, when the minimum measurement unit of timer is set to 1 μs by the SET TIMERSCALE command, and in 100 ns when the minimum is set to 100 ns.


>SHOW PERFORMANCE/TIME 1,13000,16999,500
event = 1 -> 2
min time = 11637.0
max time = 17745.0
avr time = 14538.0
time (μs)
count
0.0 - 12999.0 | 21
13000.0 - 13499.0 | 13
13500.0 - 13999.0 | 39
14000.0 - 14499.0 | 121
14500.0 - 14999.0 | 162
15000.0 - 15499.0 | 76
15500.0 - 15999.0 | 16
16000.0 - 16499.0 | 2
16500.0 - 16999.0 | 1
17000.0 - 17499.0 | 1
total | 452
Lower time limit for display
Upper time limit for display

2.2.9 Measuring Coverage

This emulator has the C0 coverage measurement function. Use this function to find now many percentage of an entire program has been executed.

■ Coverage Measurement Function

When testing a program, the program is executed with various test data input and the results are checked for correctness. When the test is finished, every part of the entire program should have been executed. If any part has not been executed, there is a possibility that the test is insufficient.

This emulator coverage function is used to find now many percentage of the whole program has been executed. In addition, details such as which addresses were not accessed can be checked.

This enables the measurement coverage range to be set and the access attributes to be measured.

To execute the C0 coverage, set a range within the code area and set the attribute to Code attribute. In addition, specifying the Read/Write attribute and setting a range in the data area, permits checking the access status of variables such as finding unused variables, etc.

■ Coverage Measurement Procedures

The procedure for coverage measurement is as follows:

- Set range for coverage measurement: SET COVERAGE
- Measuring coverage: GO, STEP, CALL
- Displaying measurement result: SHOW COVERAGE

■ Coverage Measurement Operation

The following operation can be made in coverage measurement:

- Load/Save of coverage data: LOAD/COVERAGE, SAVE/COVERAGE
- Abortion and resume of coverage measurement: ENABLE COVERAGE, DISABLE COVERAGE
- Clearing coverage data: CLEAR COVERAGE
- Canceling coverage measurement range: CANCEL COVERAGE

2.2.9.1 Coverage Measurement Procedures

The procedure for coverage measurement is as follows:

- **Set range for coverage measurement: SET COVERAGE**
- **Measure coverage: GO, STEP, CALL**
- **Display measurement result: SHOW COVERAGE**

■ Setting Range for Coverage Measurement

Use the SET COVERAGE command to set the measurement range. Up to 32 ranges can be specified.

By specifying /AUTOMATIC for the command qualifier, the code area for the loaded module is set automatically. However, the library code area is not set when the C compiler library is linked.

[Example]

```
>SET COVERAGE FF00..FFFF
```

■ Measuring Coverage

When preparing for coverage measurement, execute the program.

Measurement starts when the program is executed by using the GO, STEP, or CALL command.

■ Displaying Coverage Measurement Result

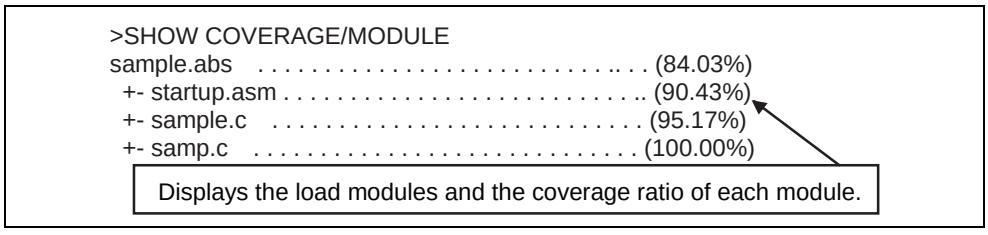
To display the measurement result, use the SHOW COVERAGE command. The following can be displayed:

- Coverage ratio of total measurement area
- Displaying coverage ratio of load module
- Summary of 16 addresses as one block
- Details indicating access status of each address
- Displaying coverage measurement result per source line
- Displaying coverage measurement result per machine instruction

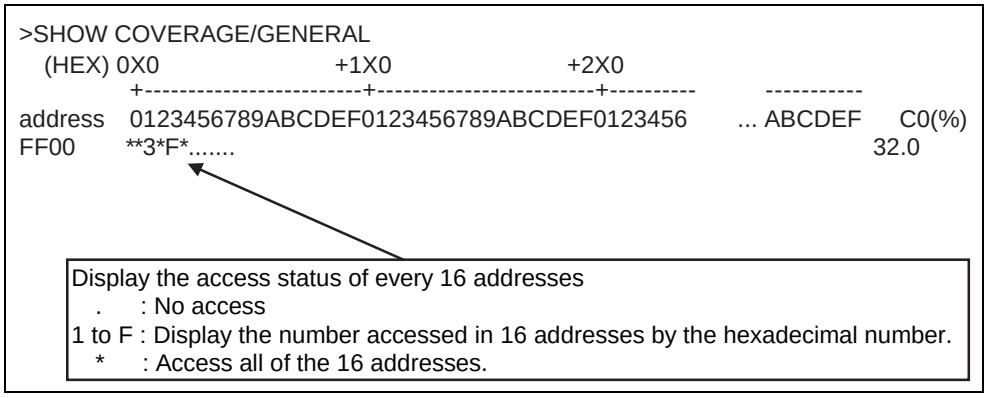
• Coverage Ratio of Total Measurement Area (Specify /TOTAL for command qualifier.)

```
>SHOW COVERAGE/TOTAL
total coverage : 82.3%
```

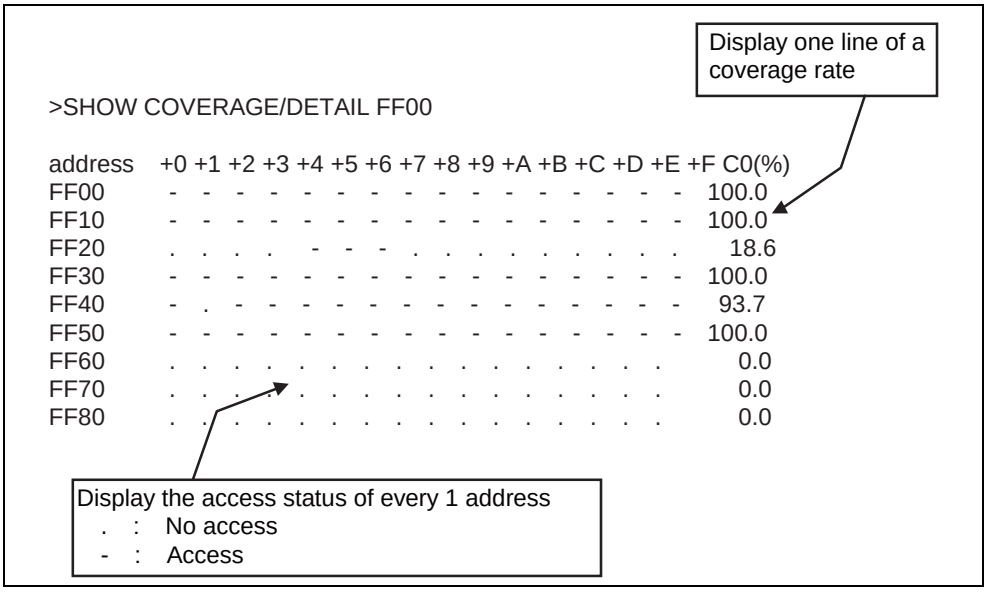
• Displaying coverage ratio of load module (specify /MODULE for the command qualifier)


>SHOW COVERAGE/MODULE
sample.abs . . . . . (84.03%)
+- startup.asm . . . . . (90.43%)
+- sample.c . . . . . (95.17%)
+- samp.c . . . . . (100.00%)
Displays the load modules and the coverage ratio of each module.

- Summary (Specify /GENERAL for command qualifier.)


>SHOW COVERAGE/GENERAL
(HEX) 0X0 +1X0 +2X0
address 0123456789ABCDEF0123456789ABCDEF0123456 ... ABCDEF C0(%)
FF00 **3*F*..... 32.0
Display the access status of every 16 addresses
. : No access
1 to F : Display the number accessed in 16 addresses by the hexadecimal number.
* : Access all of the 16 addresses.

- Details (Specify /DETAIL for command qualifier.)


Display one line of a coverage rate
>SHOW COVERAGE/DETAIL FF00
address +0 +1 +2 +3 +4 +5 +6 +7 +8 +9 +A +B +C +D +E +F C0(%)
FF00 - - - - - - - - - - - - - - - - 100.0
FF10 - - - - - - - - - - - - - - - - 100.0
FF20 . . . . - - - 18.6
FF30 - - - - - - - - - - - - - - - - 100.0
FF40 - . - - - - - - - - - - - - - - 93.7
FF50 - - - - - - - - - - - - - - - - 100.0
FF60 . . . . . 0.0
FF70 . . . . . 0.0
FF80 . . . . . 0.0
Display the access status of every 1 address
. : No access
- : Access

- Displays per source line (specify /SOURCE for the command qualifier)

```
>SHOW COVERAGE/SOURCE main
 *        70: {
          71:             int        i;
          72:             struct table *value[16];
          73:
 *        74:             for (i=0; i<16; i++)
 *        75:                       value[i] = &target[i];
          76:
 *        77:             sort_val(value, 16L);
 .        78: }
```

Displays access status of each source line.
. : No Access
* : Accessed
Blank : Line which the code had not been generated or is outside the s cope of the coverage measurement

- Displays per machine instruction (specify /INSTRUCTION for the command qualifier)

```
>SHOW COVERAGE/INSTRUCTION C304
sample.c$70 {
 *  C304: 41              PUSHW    IX
 *  C305: F1              MOVW     A,SP
 *  C306: E2              MOVW     IX,A
 *  C307: E40024          MOVW     A,#0024
 *  C30A: 81              CLRC
 *  C30B: 33              SUBCW    A
 *  C30C: E1              MOVW     SP,A
sample.c$74         for (i=0; i<16; i++)
 .  C30D: E40000          MOVW     A,#0000
 .  C310: D6FE            MOVW     @IX-02,A
 .  C312: C6FE            MOVW     A,@IX-02
 .  C314: E40010          MOVW     A,#0010
 .  C317: 13              CMPW     A
 .  C318: FE2C            BGE      C346
sample.c$75          value[i] = &target[i];
 .  C31A: F2              MOVW     A,IX
 .  C31B: E40024          MOVW     A,#0024
 .  C31E: 81              CLRC
```

Displays access status of each source line .
. : No Access
* : Accessed
Blank : Instruction outside the scope of the coverage measurement

Note:

With MB2141 emulator, the code coverage is affected by a prefetch. Note when analyzing.

2.2.10 Execution Time Measurement

This section describes the execution time measurement function.

■ Item to be Measured

The program execution time is measured.

This is done every time when a program is executed, and two values are displayed as measurement results, as follows.

- Execution time of the program just completed.
- Sum of execution duration since the last clearance

The maximum value can vary depending on the measurement unit specified.

The minimum measurement value can either be set as 1μs or 100ns. The default selection is 1μs.

When 1μs is selected: 70 minutes is the maximum
When 100ns is specified: 7 minutes is the maximum

■ Setting the Measurement Unit

The minimum measurement unit can be set as follows.

- Dialog
  - Debug environment setting dialog [emulation] tab
    Refer to section "4.7.2.3 Debug Environment" of "SOFTUNE Workbench Operation Manual".
- Command
  - SET TIMERSCALE
    Refer to section "1.6 SET TIMERSCALE" of "SOFTUNE Workbench Command Reference Manual".

■ Displaying of Measurement Result

The measurement results can be displayed using the following methods.

- Dialog
  - Time measurement dialog
    Refer to section "4.6.8 Time Measurement" of "SOFTUNE Workbench Operation Manual".
- Command
  - SHOW TIMER
    Refer to "4.19 SHOW TIMER" of "SOFTUNE Workbench Command Reference Manual".

■ Clearing of Measurement Results

The measurement results can be cleared using the following methods.

- Dialog
  - Time measurement dialog
    Refer to section "4.6.8 Time Measurement" of "SOFTUNE Workbench Operation Manual".
- Command
  - CLEAR TIMER
    Refer to "4.20 CLEAR TIMER" of "SOFTUNE Workbench Command Reference Manual".

2.2.11 Sampling by External Probe

An external probe can be used to sample (input) data. There are two sampling types: sampling the trace buffer as trace data, and sampling using the SHOW SAMPLING command.

■ Sampling by External Probe

There are two sampling types to sample data using an external probe: sampling the trace buffer as trace data, and sampling using the SHOW SAMPLING command.

When data is sampled as trace data, such data can be displayed by using the SHOW TRACE command or SHOW MULTITRACE command, just as with other trace data. Sampling using the SHOW SAMPLING command, samples data and displays its state.

In addition, by specifying external probe data as events, such events can be used for aborting a program, and as multi trace and performance trigger points.

Events can be set by using the SET EVENT command.

■ External Probe Sampling Timing

Choose one of the following for the sampling timing while executing a program.

- At rising edge of internal clock (clock supplied by emulator)
- At rising edge of external clock (clock input from target)
- At falling edge of external clock (clock input from target)

Use the SET SAMPLING command to set up; to display the setup status use the SHOW SAMPLING command.

When sampling data using the SHOW SAMPLING command, sampling is performed when the command is executed and has nothing to do with the above settings.

[Example]

```
>>SET SAMPLING/INTERNAL
>>SHOW SAMPLING
sampling timing : internal
channel        7 6 5 4 3 2 1 0
               1 1 1 1 0 1 1 1
```

■ Displaying and Setting External Probe Data

When a command that can use external probe data is executed, external probe data is displayed in 8-digit binary or 2-digit hexadecimal format. The displayed bit order is in the order of the IC clip cable color code order (Table 2.2-11). The MSB is at bit7 (Violet), and the LSB is at bit0 (Black). The bit represented by 1 means HIGH, while the bit represented by 0 means LOW. When data is input as command parameters, these values are also used for input.

Table 2.2-11 Bit Order of External Probe Data

IC Clip Cable Color	Violet	Blue	Green	Yellow	Orange	Red	Brown	Black
Bit Order	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
	External probe data							

■ Commands for External Probe Data

Table 2.2-12 shows the commands that can be used to set or display external probe data.

Table 2.2-12 Commands that can be used External Probe Data

Usable Command	Function
SET SAMPLING	Sets sampling timing for external probe
SHOW SAMPLING	Samples external probe data
SET EVENT	Enables to specify external probe data as condition for event 1
SHOW EVENT	Displays event setup status
SHOW TRACE	Displays external probe trace-sampled (single trace)
SHOW MULTITRACE	Displays external probe trace-sampled (multi-trace)

2.2.12 Confirming the Debugger's State

This section explains methods of confirming the debugger's state and its information.

■ Debugger Information

The following information can be obtained at the debugger's startup.

- File information of SOFTUNE Workbench
- Hardware-related information

If problems are encountered with SOFTUNE Workbench and its behavior, refer to the information before contacting the Sales Representatives.

■ Confirmation Method

Debugger's information can be confirmed as follows.

- Command
  - SHOW SYSTEM
    Refer to section "1.12 SHOW SYSTEM" of "SOFTUNE Workbench Command Reference Manual".
- Dialog
  - Version information dialog
    Refer to section "4.9.3 Version Information" of "SOFTUNE Workbench Operation Manual".

■ Content to be Displayed

```
F2MC-8L/8FX Family SOFTUNE Workbench VxxLxx
ALL RIGHTS RESERVED,
  COPYRIGHT(C) FUJITSU SEMICONDUCTOR LIMITED 1997
LICENCED MATERIAL -
  PROGRAM PROPERTY OF FUJITSU SEMICONDUCTOR LIMITED
=====================================================
Cpu information file path    : Path to the CPU information file
Cpu information file version : Version of the CPU information file
=====================================================
Add in DLLs
-----------------------------------------------------
 SiCmn
 Product name        : SOFTUNE Workbench
 File Path           : Path to SiC896.dll
 Version             : Version of SiC896.dll
- - - - - - - - - - - - - - - - - - - - - - - - - - -
 SiiEd
 File Path           : Path to SiiEd3.ocx
 Version             : Version of SiiEd3.ocx
-----------------------------------------------------
 SiM896
 Product name        : SOFTUNE Workbench
 File Path           : Path to SiM896.dll
 Version             : Version of SiM896.dll
- - - - - - - - - - - - - - - - - - - - - - - - - - -
Language Tools
 - Compiler
   File Path         : Path to fcc896s.exe
 - Assembler
   File Path         : Path to fasm896s.exe
```

```
 - Linker
   File Path         : Path to flnk896s.exe
 - Librarian
   File Path         : Path to flib896s.exe
 - FJ-OMF to S-FORMAT Converter
   File Path         : Path to f2ms.exe
 - FJ-OMF to INTEL-HEX Converter
   File Path         : Path to f2is.exe
 - FJ-OMF to INTEL-EXT-HEX Converter
   File Path         : Path to f2es.exe
 - FJ-OMF to HEX Converter
   File Path         : Path to f2hs.exe
-------------------------------------------------------
 SiOsM
 Product name        : SOFTUNE Workbench
 File Path           : Path to SiOsM896.dll
 Version             : Version of SiOsM896.dll
-------------------------------------------------------
 F2MC-8L/8FX Series Debugger DLL
 Product name        : SOFTUNE Workbench
 File Path           : Path to SiD896.dll
 Version             : Version of SiD896.dll
- - - - - - - - - - - - - - - - - - - - - - - - - - - - -
Debugger type        : Current debugger type
MCU type             : Currently selected target MCU
VCpu dll name        : Path and name of currently selected virtual debugger section DLL
VCpu dll version     : Version of currently selected virtual debugger section DLL
Monitor version      : Monitor (dependent) version
MCU frequency        : Operation frequency
Communication device : Device type
Host name            : LAN host name
-------------------------------------------------------
 SiIODef
 Product name        : SOFTUNE Workbench
 File Path           : Path to SiIODef.dll
 Version             : Version of SiIODef.dll
=======================================================
Current path         : Currently specified project path
Language             : Currently selected language
Help file path       : Path to the help files
```

2.3 Emulator Debugger (MB2146-09/09A/09B)

This section describes the functions of the emulator debugger (MB2146-09/09A/09B).

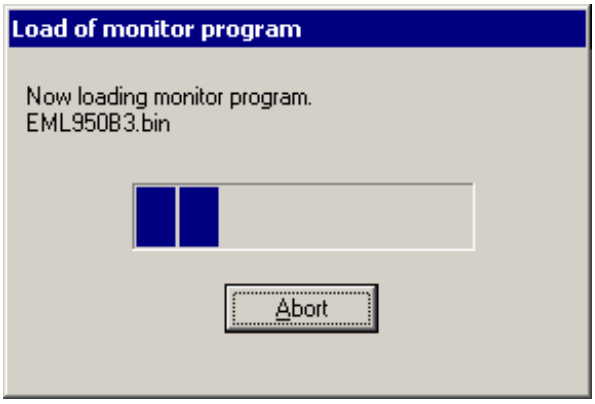
■ Emulator Debugger (MB2146-09/09A/09B)

The emulator debugger for the F^2MC-8FX family is a software package that you can use to test program execution via a USB communication link from a host computer.

■ Before Use

When using the MB2146-09, 09A or 09B, refer to "Appendix D Setting USB Interface" in "SOFTUNE Workbench Operation Manual" to setup the USB interface.

The monitor program is loaded automatically when the debugger starts immediately after the power is turned on to the user system. The following dialog is displayed while the monitor program is loaded. Once loaded, the monitor program isn't reloaded unless the power is turned off. The monitor program is located in the Lib\896 sub-directory under the directory in which Workbench is installed.



■ Extended Debugging Functions

In addition to the basic debug functions, the following additional functions also become available with certain combinations of BGM adapter and MCU board.

1. Function to measure the number of execution cycles
2. Function to monitor RAM

Table 2.3-1 shows debug functions for different BGM adapter and MCU board combinations. The version number of the MCU board is shown on a sticker affixed to the board.

Table 2.3-1 Debug Functions for Different BGM Adapter and MCU Board Combinations (1 / 2)

BGM adapter	MCU Board		Debugger launched	RAM monitoring	Measuring the number of execution cycles
	Model	Version No.			
MB2146-09B	MB2146-303B	02B and later	❍	❍	❍
		01A	❍	❍	❍
	MB2146-301B	02B and later	❍	❍	❍
		01A	❍	❍	❍
	MB2146-303A-E	02B and later	❍	×	❍
		01A	❍	×	❍
	MB2146-302A-E	02B and later	❍	×	❍
		01A	❍	×	❍
	MB2146-301A-E	02B and later	❍	×	❍
		01A	❍	×	❍
	MB2146-303A	02B and later	❍	×	❍
		01A	❍	×	×
	MB2146-302A	02B and later	❍	×	❍
		01A	❍	×	×
	MB2146-301A	02B and later	❍	×	❍
		01A	❍	×	×
MB2146-09A	MB2146-303B	02B and later	×	-	❍
		01A	❍	×	❍
	MB2146-301B	02B and later	×	-	❍
		01A	❍	×	❍
	MB2146-303A-E	02B and later	×	-	❍
		01A	❍	×	❍
	MB2146-302A-E	02B and later	×	-	❍
		01A	❍	×	❍
	MB2146-301A-E	02B and later	×	-	❍
		01A	❍	×	❍
	MB2146-303A	02B and later	❍	×	❍
		01A	❍	×	×

Table 2.3-1 Debug Functions for Different BGM Adapter and MCU Board Combinations (2 / 2)

BGM adapter	MCU Board		Debugger launched	RAM monitoring	Measuring the number of execution cycles
	Model	Version No.			
MB2146-09A	MB2146-302A	02B and later	❍	×	❍
		01A	❍	×	×
	MB2146-301A	02B and later	❍	×	❍
		01A	❍	×	×
MB2146-09	MB2146-303B		×	-	-
				-	-
	MB2146-301B	02B and later	×	-	-
		01A	×	-	-
	MB2146-303A-E	02B and later	×	-	-
		01A	×	-	-
	MB2146-302A-E	02B and later	×	-	-
		01A	×	-	-
	MB2146-301A-E	02B and later	×	-	-
		01A	×	-	-
	MB2146-303A	02B and later	❍	×	×
		01A	❍	×	×
	MB2146-302A	02B and later	❍	×	×
		01A	❍	×	×
	MB2146-301A	02B and later	❍	×	×
		01A	❍	×	×

❍ : available

× : not available

Note:

If the combination of the BGM adaptor and the MCU board is not one of the combinations in Table 2.3-1, an error message appears at the startup of the debugger and the debugger cannot be started. Refer to "Appendix B Debugger Related Error Messages" in the "SOFTUNE Workbench Command Reference Manual".

2.3.1 Setting Operating Environment

This section explains the operating environment setup.

■ Setting Operating Environment

For the emulator debugger for the MB2146-09, it is necessary to set the following items according the operating environment. Predefined default settings for all these setup items are enabled at startup. Therefore, it is not required to change the settings when using the default settings. Adjusted settings can be used as new default settings from the next time.

- Clock-up mode
- Main Clock Oscillation

2.3.1.1 Clock-up Mode

This section explains the clock-up mode.

■ Clock-up Mode

The MB2146-09 and communication speed of user system change by the operating frequency of the target MCU. When the operating frequency is reduced, especially in the sub clock mode, communication speed is also reduced. In this case, optimize the communication speed, the function increasing the operating frequency automatically is called clock-up mode. The default is enabled.

■ Setting Method

Set the clock-up mode as follows.

- Dialog
  - Setup Wizard
    Refer to "4.7.2.4 Setup Wizard" of "SOFTUNE Workbench Operation Manual".
- Dialog
  - [Response Speed] tab in the debug environment setting dialog
    Refer to "4.7.2.3 Debug Environment" of "SOFTUNE Workbench Operation Manual".

Notes:

- When the clock-up mode is used, the operating frequency is changed automatically at breaking. If the failure is caused by changing the operating frequency, disables the clock-up modes.
- If a break occurs immediately after changing the system clock mode by the user program, no clock up is performed during oscillations stabilization wait state. Clock up will be performed when oscillations are stabilized.

2.3.1.2 Main Clock Oscillation

This section explains the main clock oscillation frequency.

■ Main Clock Oscillation

The MB2146-09 and communication speed of user system change by the operation frequency of the target MCU. The setting of the main clock oscillation (F_{CH}) is required to calculate the operating speed of the target MCU. The default is the maximum frequency that specified MCU operates in the main clock.

■ Setting Method

Set the clock oscillation frequency as follows.

- Dialog
  - Setup wizard
    Refer to "4.7.2.4 Setup Wizard" of "SOFTUNE Workbench Operation Manual".

2.3.2 Programming to FLASH Memory

This emulator supports programming to the FLASH memory.

■ Erasing/Programming FLASH Memory

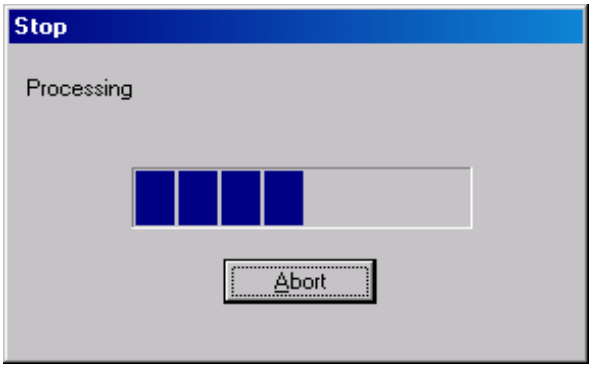
Writing to FLASH memory/code break (software break) functions are supported. The content of FLASH memory is secured in the buffer within the debugger, and the content of the buffer is referenced at reading/ writing.

Writing FLASH memory is carried out automatically in the following cases.

- Before program execution processing
- Before reset processing
- Before end of debugging

When necessary, it can be carried out manually instead of via the above-mentioned processing.

The following dialog is displayed at writing to FLASH memory.



There are the following three functions for the operation of FLASH memory:

1. Updating FLASH memory

   ([Environment] - [FLASH area control] - [Download FLASH memory] menu).

   Updates Flash memory. FLASH memory is usually updated automatically prior to executive operation or reset processing. Use this menu when updating Flash memory before this automatic updating.

   This menu is enabled when data in the FLASH memory area is changed, requiring the writing to of FLASH memory.

2. Uploading FLASH memory

   ([Environment] - [FLASH area control] - [Upload FLASH memory] menu).

   Reads the contents of FLASH memory, and synchronizes with a buffer in the debugger. Be sure to perform this synchronization when FLASH memory is rewritten (updated) by the user program, or the program would not operate properly.

3. Erasing FLASH memory

([Environment] - [FLASH area control] - [Erase FLASH memory] menu).

Erase all data in FLASH memory. Note that this operation will erase all code break (software break) settings.

2.3.3 Break

This Debugger provides five types of break functions.

■ Break Functions

This Debugger provides the following five types of break functions;

- Code break
- Data break
- Monitoring Data Break
- Sequential break
- Forced break

2.3.3.1 Code Break

This function aborts the program execution by monitoring a specified address by software. A break occurs before executing an instruction at the specified address.

■ Code Break

This function aborts the program execution by monitoring a specified address by software. A break occurs before executing an instruction at the specified address.

Up to 256 addresses can be set for this debugger.

When the code break occurs, the following message appears at the status bar.

Break at address by breakpoint

■ Setting Method

Set code break as follows.

- Command
  - SET BREAK
    Refer to "3.1 SET BREAK (type 1)" of "SOFTUNE Workbench Command Reference Manual".
- Dialog
  - "Code" tab in breakpoint setting dialog
    Refer to "4.6.4 Breakpoint" of "SOFTUNE Workbench Operation Manual".
- Window
  - Source window/disassemble window
    Refer to "3.7 Source Window" or "3.9 Disassemble Window" of "SOFTUNE Workbench Operation Manual".

2.3.3.2 Data Break

It is a function to abort the program execution when the data access (read or write) is done to a specified address.

■ Data Break

This function aborts the program execution when a data access (read/write) is made to a specified address.

Up to 2 data break points can be set for this debugger.

When the data break occurs, the following message appears at the status bar.

Break at address by databreak at access address

■ Setting Method

Set the data break as follows.

- Command
  - SET DATABREAK
    Refer to "3.9 SET DATABREAK (type 1)" of "SOFTUNE Workbench Command Reference Manual".
- Dialog
  - "Data" tab in breakpoint setting dialog
    Refer to "4.6.4 Breakpoint" of "SOFTUNE Workbench Operation Manual".

Note:

When set as the monitoring data break, a break does not occur as the data break.

2.3.3.3 Monitoring Data Break

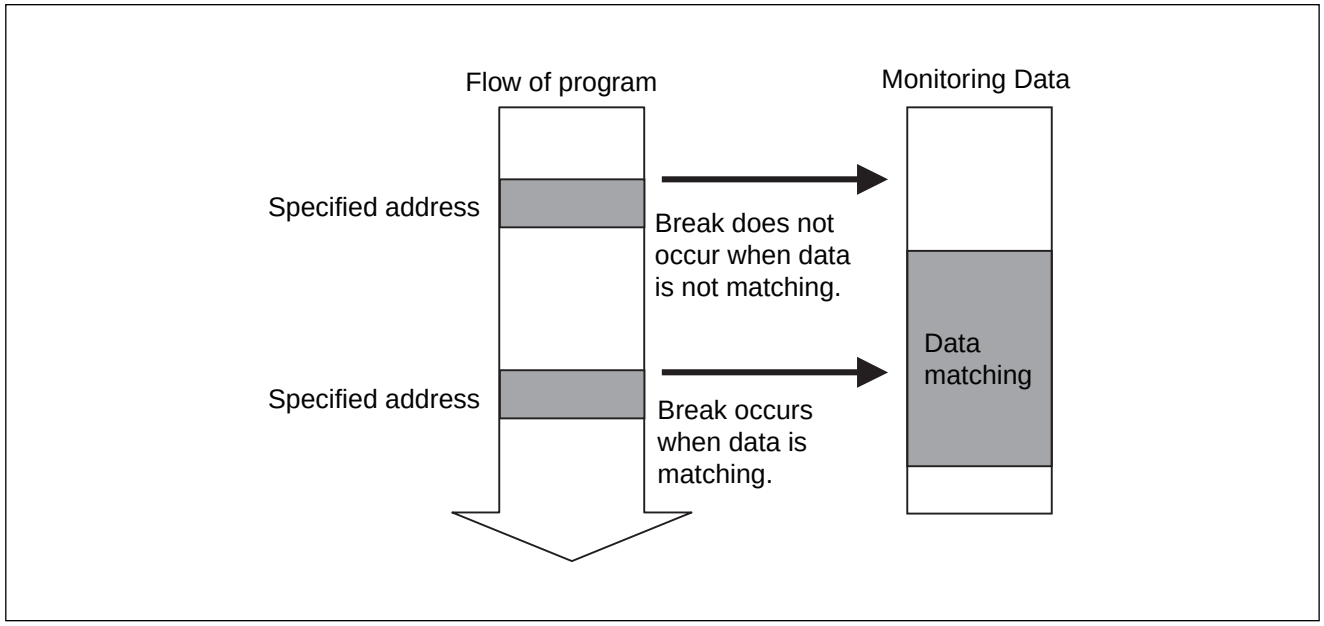
It is a special break function to abort execution while it is corresponding to specified data when the program reaches a specified address.

■ Monitoring Data Break

It is a special break function to abort execution while it is corresponding to specified data when the program reaches a specified address.

The following figure shows the break conditions of the monitoring data break.

Figure 2.3-1 Break Conditions of Monitoring Data Break



■ Setting Method

Set the monitoring data break as follows.

- Command
  - SET BREAK /DATAWATCH
    Refer to "3.2 SET BREAK (type 2)" of "SOFTUNE Workbench Command Reference Manual".
- Dialog
  - "Data" tab in breakpoint setting dialog
    Refer to "4.6.4 Breakpoint" of "SOFTUNE Workbench Operation Manual".

2.3.3.4 Sequential Break

A sequential break is a function to abort an executing program, when it is executed in the order of level 1 and then level 2 at two specified addresses.

■ Sequential Break

A sequential break is a function to abort an executing program, when it is executed in the order of level 1 and then level 2 at two specified addresses. One break can be set for this debugger.

When the Sequential break occurs, the following message appears at the status bar.

Break at address by hardware breakpoint

■ Setting Method

Set the Sequential break as follows.

- Command
  - SET BREAK /SEQUENCE
    Refer to "3.3 SET BREAK (type 3)" of "SOFTUNE Workbench Command Reference Manual".
- Dialog
  - "Sequential" tab in breakpoint setting dialog
    Refer to "4.6.4 Breakpoint" of "SOFTUNE Workbench Operation Manual".

2.3.3.5 Forced Break

This function forcibly aborts the program execution to generate a break.

■ Forced Break

This function forcibly aborts the program execution to generate a break.

When the forced break occurred, the following message appears at the status bar.

Break at address by command abort request

■ Generation Method

The methods of generating forced breaks are as follows.

- Menu
  - [Debug]-[Abort] menu
    Refer to "4.6.2 Abort" of "SOFTUNE Workbench Operation Manual".
- Command
  - ABORT
    Refer to "2.2 ABORT" of "SOFTUNE Workbench Command Reference Manual".

2.3.4 Real-time Trace

While execution a program, the executed address information is sampled and stored in the trace buffer. This function is called "trace".

■ Trace

The program execution history can be analyzed from the data stored by the trace buffer.

Since the trace buffer has a ring structure, when it becomes buffer-full, it automatically returns to the start to overwrite existing data.

■ Trace Data

The stored data sampled by the trace is called trace data.

For the emulator debugger of the MB2146-09, 16 divergences immediately before the execution interruption can be sampled.

Note:

When 4096 or more branch instructions are not executed, only 4096 instructions from the branch destination address is displayed.

■ Sampling Trace Data

When the trace function is enabled, the data is sampled during command execution, and it is stored in the trace buffer.

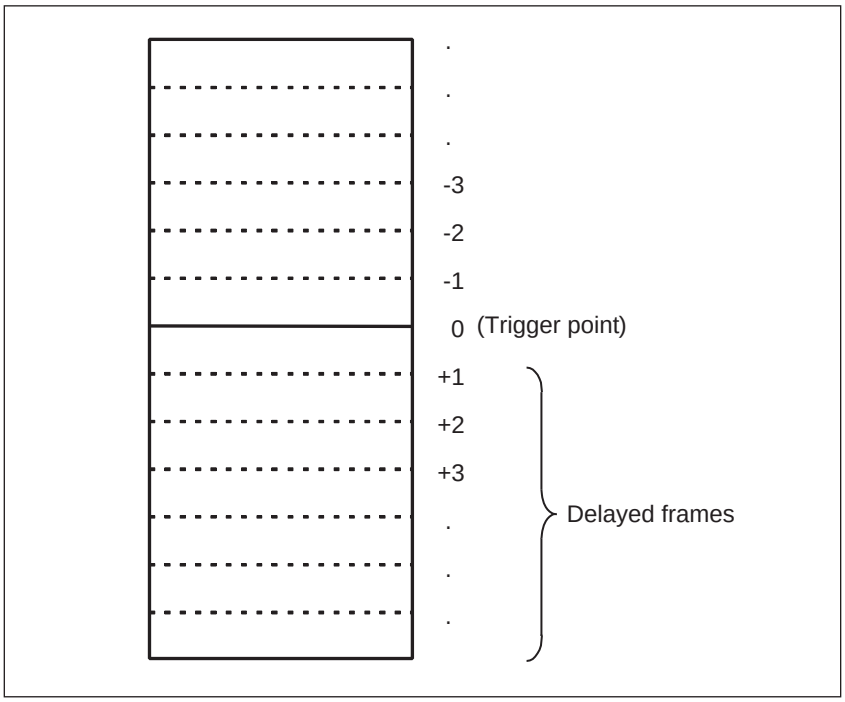
When the program execution is stopped by the break cause such as break point, the trace sampling is ended.

■ Frame number

A number is assigned to each frame of sampled trace data. This number is called a frame number.

The frame number is used to specify the display start position of the trace buffer. The value 0 is assigned to trace data at the position for current program counter (PC). Negative values are assigned to previous trace data.

Figure 2.3-2 Frame Number in Trace



2.3.4.1 Displaying Trace Data

The data stored in the trace buffer is displayed.

■ Displaying Trace Data Storage Information

Trace window is displayed how much trace data is stored in the trace buffer. Also, the command displays by SHOW TRACE/STATUS.

■ Display Format of Trace Data

There are two types of display format for the trace buffer.

- Display instruction execution only (Display instruction)
  Display the instruction execution in disassembly unit.
- Display in source line units (Display source)
  Display the source line only.

■ Clearing Trace Data

When the trace data is cleared, execute [Clear] within the shortcut menu in the trace window. Also, the command executes the CLEAR TRACE command.

Note:

When the emulator debugger for the MB2146-09 is used, the address information is outputted at the branch instruction fetch, the trace is implemented.

At that time, notes the following points related to display trace data.

The disassembly display is performed after reading from the memory. In this case, when the instruction is completed to write after the code fetch, it does not display correctly.

2.3.4.2 Saving Trace Data

This section explains the methods to save trace data.

■ Saving Trace Data

Trace data can be saved into a specified file.

Both GUI (via window or dialog) and command-only methods can be used. These methods give the same results.

- Saving via GUI
  1. Display the trace window.
     - Select [Display] - [Trace] in the menu.
  2. Specify a file name to which the trace data will be saved.
     - Right-click on the trace window, and select [save] in the pop-up menu. "Save As..." dialog is displayed.
       Here, specify the file name and directory to where you wish to store the file.
       Refer to section "4.4.8 Trace" of "SOFTUNE Workbench Operation Manual" for detailed information.

- Saving via command
  Save the trace data.
     - Execute SHOW TRACE/FILE command.
       Refer to section "4.22 SHOW TRACE (type 1)" of "SOFTUNE Workbench Command Reference Manual" for detailed information.
       To append and save data to an existing file, execute SHOW TRACE/FILE/APPEND command.

2.3.4.3 Searching Trace Data

This section explains the methods to search trace data.

■ Searching Trace Data

This function searches for trace data at a specified address or in a specified frame.

Both GUI (via window or dialog) and command-only methods can be used. These methods give the same results.

- Searching via GUI
  1. Display the trace window.
     - Select [Display] - [Trace] in the menu.
  2. Specify the address or the frame number that you wish to search.
     - Right-click on the trace window, and select [search] in the pop-up menu. Trace search dialog is displayed.
       Here, specify the address or the frame number that you wish to be displayed. Refer to section "4.4.8 Trace" of "SOFTUNE Workbench Operation Manual" for detailed information.

- Searching via command
  Search the trace data.
     - Execute SEARCH TRACE command.
       Refer to section "4.23 SEARCH TRACE" of "SOFTUNE Workbench Command Reference Manual" for detailed information.

2.3.5 Notes on Executing Program

This emulator notes the following points.

■ Break at Standby Mode

When the abort operation is executed in the standby mode, the debugger cancels the standby mode and aborts the execution. Therefore, it is aborted in next address of instruction to be transmitted to the standby mode.

2.3.6 RAM Monitoring

MB2146-09 emulator can monitor the memory content of certain address during the user program is running.

■ RAM Monitoring

This function monitors the memory content of certain address during the user program is running.

Up to 32 addresses in 16 bit units can be set.

Those addresses are monitored in the RAM monitoring window.

■ Conditions for Use

RAM monitoring can be used under the following conditions.

SOFTUNE Workbench:	Version V30L32 or later
BGM adapter:	Model MB2146-09B-E
MCU board:	Model MB2146-301B-E/303B-E

■ Setting Method

Set RAM monitoring as follows.

- Command
  - SET RAMMONITOR
    Refer to Section "4.28 SET RAM MONITOR" of "SOFTUNE Workbench Command Reference Manual".
- Dialog
  - RAM monitoring setting dialog
    Refer to Section "4.4.15 RAM monitoring" of "SOFTUNE Workbench Operation Manual".

■ Halt Time During Monitoring

To read data, the RAM monitoring function must temporarily halt and then restart the user program.

The formulas below calculate the number of times the user program is halted and the halt duration for each read operation.

Number of times the user program halts = 2 × <no. of bytes read>

Total user program halt duration = <Number of times the user program halts> × <Halt time> *

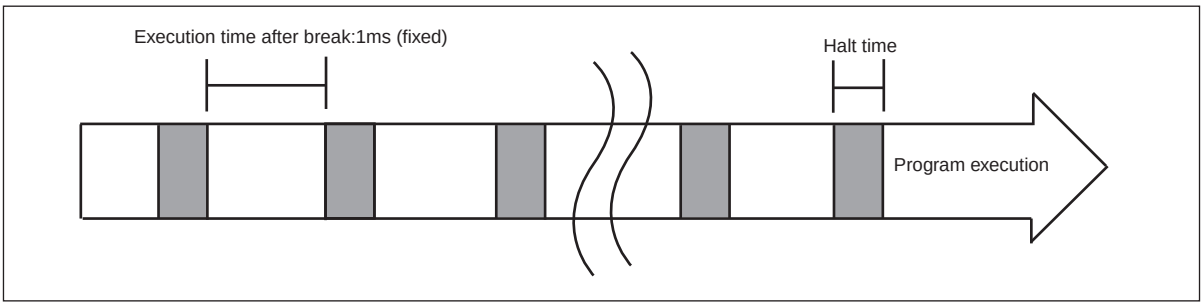
* : Duration of each halt

This varies as follows depending on the operating frequency (F_{ch}).

Table 2.3-2 Operating Frequency vs. Halt Duration

Operating Frequency [MHz]	Duration of Halt [μs]
16	approx. 22
10	approx. 35
8	approx. 44
4	approx. 88
2	approx. 175

As user program halts are performed at 1.5ms intervals (fixed), user program execution operates as shown in the figure below during monitoring.



Accordingly, the total halt time for the user program when reading four bytes is as follows.

Example: Reading four bytes at an operating frequency of 16MHz.

Number of user program halts = $2 \times 4 = 8$

Total user program halt time = $22 \times 8 = 176$ μs

Note:

As this function performs a pseudo-on-the-fly memory read, the execution halt time may become long if not a few variables have been registered.

2.3.7 Measuring the Number of Execution Cycles

MB2146-09B emulator can measure the number of program execution cycles.

■ Measuring the Number of Execution Cycles

This function measures the number of program execution cycles.

Measuring is performed whenever the program is executed, the following two values are displayed.

- Number of execution cycles for the previous program execution
- Total number of execution cycles up to that time after the debugger has started

The default maximum value for the measurement result is 65535 cycles.

■ Conditions for Use

Measuring the number of execution cycles can be used under the following conditions.

SOFTUNE Workbench:	Version V30L30 or later
BGM adapter:	Model MB2146-09
MCU board:	Model MB2146-301A/302A/303A (Version 02B or later)

When this function is used, the following internal resource is used by the debugger.

Note that this means the resource cannot be used by the user program.

16-bit reload timer ch.1

■ How to Extend the Measurement Range

The default maximum value for the measurement result is 65535 cycles, but this can be extended to a maximum of 4294967295 cycles.

Extending the measurement range requires that you link the relative-format load module file from the following directory into the user program.

<SOFTUNE installation directory>\Lib\896\EXETMR.REL

If using this library, the following resources are also used.

Interrupt vector:	IRQ17
Interrupt handler:	User ROM (16 bytes)
Overflow counter:	User RAM (2 bytes: 0x0F7E to 0x0F7F)
Reserved symbol name:	__EXETMROVRHDR
	__EXTTMROVRHDRVER

■ Displaying the Measurement Result

The following methods can be used to display the results.

1. Time measurement dialog
   [Debug] - [Time Measurement] menu
2. SHOW TIMER command

■ Clearing the Measurement Result

The following methods can be used to clear the results.

- Command
  - CLEAR TIMER
    Refer to "4.20 CLEAR TIMER" of "SOFTUNE Workbench Command Reference Manual".
- Dialog
  - Time measurement dialog
    Refer to "4.6.8 Time Measurement" of "SOFTUNE Workbench Operation Manual".

■ Error

The measurement result for the number of execution cycles has an error of around zero to ten or so cycles.

The following additional error also occurs if the measurement range is extended.

Error = Overflow counter (upper 16 bits) × N^{*}

*: 0 to 10 or so cycles (approx.)

Notes:

- To minimize the error when measuring the number of execution cycles, use continuous instruction execution as far as possible.
- It is possible that 16-bit counter overflow events may be missed if interrupts are disabled for a long period of time. In this case, the measurement result will not be correct.
- The following reserverd symbols can be referenced, but do not define them.
  __EXETMROVRHDR
  __EXTTMROVRHDRVER

2.3.8 Confirming the Debugger's State

This section explains various methods of confirming the debugger's state and its information.

■ Debugger Information

With this emulator debugger, the following information can be obtained at the time of startup.

- File information of SOFTUNE Workbench
- Hardware-related information

If problems are encountered with SOFTUNE Workbench and its behavior, refer to the information before contacting the Sales Representatives.

■ Confirmation Method

Debugger's information can be confirmed as follows.

- Command
  - SHOW SYSTEM
    Refer to section "1.12 SHOW SYSTEM" of "SOFTUNE Workbench Command Reference Manual".
- Dialog
  - Version information dialog
    Refer to section "4.9.3 Version Information" of "SOFTUNE Workbench Operation Manual".

■ Content to be Displayed

```
F2MC-8L/8FX Family SOFTUNE Workbench VxxLxx
ALL RIGHTS RESERVED,
  COPYRIGHT(C) FUJITSU SEMICONDUCTOR LIMITED 1997
LICENCED MATERIAL -
  PROGRAM PROPERTY OF FUJITSU SEMICONDUCTOR LIMITED
=====================================================
Cpu information file path    : Path to the CPU information file
Cpu information file version : Version of the CPU information file
=====================================================
Add in DLLs
-----------------------------------------------------
 SiCmn
 Product name        : SOFTUNE Workbench
 File Path           : Path to SiC896.dll
 Version             : Version of SiC896.dll
- - - - - - - - - - - - - - - - - - - - - - - - - - - -
 SiiEd
 File Path           : Path to SiiEd3.ocx
 Version             : Version of SiiEd3.ocx
-----------------------------------------------------
 SiM896
 Product name        : SOFTUNE Workbench
 File Path           : Path to SiM896.dll
 Version             : Version of SiM896.dll
- - - - - - - - - - - - - - - - - - - - - - - - - - - -
Language Tools
 - Compiler
   File Path         : Path to fcc896s.exe
 - Assembler
```

```
   File Path         : Path to fasm896s.exe
 - Linker
   File Path         : Path to flnk896s.exe
 - Librarian
   File Path         : Path to flib896s.exe
 - FJ-OMF to S-FORMAT Converter
   File Path         : Path to f2ms.exe
 - FJ-OMF to INTEL-HEX Converter
   File Path         : Path to f2is.exe
 - FJ-OMF to INTEL-EXT-HEX Converter
   File Path         : Path to f2es.exe
 - FJ-OMF to HEX Converter
   File Path         : Path to f2hs.exe
-------------------------------------------------------
 SiOsM
 Product name        : SOFTUNE Workbench
 File Path           : Path to SiOsM896.dll
 Version             : Version of SiOsM896.dll
-------------------------------------------------------
 F2MC-8L/8FX Series Debugger DLL
 Product name        : SOFTUNE Workbench
 File Path           : Path to SiD896.dll
 Version             : Version of SiD896.dll
- - - - - - - - - - - - - - - - - - - - - - - - - - - - -
Debugger type        : Current debugger type
MCU type             : Currently selected target MCU
VCpu dll name        : Path and name of currently selected virtual debugger section DLL
VCpu dll version     : Version of currently selected virtual debugger section DLL
Adapter type         : BGM adapter currently used
Adapter version      : Version of the adapter
Target type          : BGM target currently used
Target version       : BGM target version
Communication device : Device type
-------------------------------------------------------
 SiIODef
 Product name        : SOFTUNE Workbench
 File Path           : Path to SiIODef.dll
 Version             : Version of SiIODef.dll
=======================================================
Current path         : Currently specified project path
Language             : Currently selected language
Help file path       : Path to the help files
```

2.4 Emulator Debugger (MB2146-08)

This section explains the functions of the emulator debugger (MB2146-08) for the F^{2}MC-8FX Family.

■ Emulator Debugger

The emulator debugger (MB2146-08) for the F^{2}MC-8FX Family is software that controls an emulator from a host computer via a communications line (USB) to evaluate programs.

■ Before Use

Before using the MB2146-08, confirm the following.

- Combination of BGM adapter and MCU board
  Your hardware manual or data sheet
- Setup of USB interface
  "Appendix DUSB Interface Settings" of "SOFTUNE Workbench Operation Manual"

Note:

If the combination of the BGM adaptor and the MCU is incorrect, an error message appears at the startup of the debugger and the debugger cannot be started.

For details, refer to "Appendix B Debugger Related Error Messages" of "SOFTUNE Workbench Command Reference Manual".

2.4.1 Setting Operating Environment

This section explains the operating environment setup.

■ Setting Operating Environment

For this debugger, it is necessary to set the following operating environment. Predefined default settings for all these setup items are enabled at startup. Therefore, setup is not required when using the default settings. Adjusted settings can be used as new default settings from the next time.

- Main clock oscillation frequency

2.4.1.1 Main Clock Oscillation Frequency

This section explains the main clock oscillation frequency.

■ Setting Main Clock Oscillation Frequency

The communication speed of MB2146-08 and the user system changes depending on the operating frequency of the target MCU. The setting of the main clock oscillation (FCH) is required to calculate the operating speed of the target MCU. The default setting is the maximum frequency at which the specified MCU operates in the main clock.

■ Setting Method

Set the clock oscillation frequency as follows.

- Dialog
  - Setup wizard
    Refer to "4.7.2.4 Setup Wizard" of "SOFTUNE Workbench Operation Manual".

Note:

Use the default setting when only the internal main CR clock is used.

2.4.2 Erasing/Programming FLASH Memory

This debugger supports programming to the FLASH memory.

■ Erasing/Programming FLASH Memory

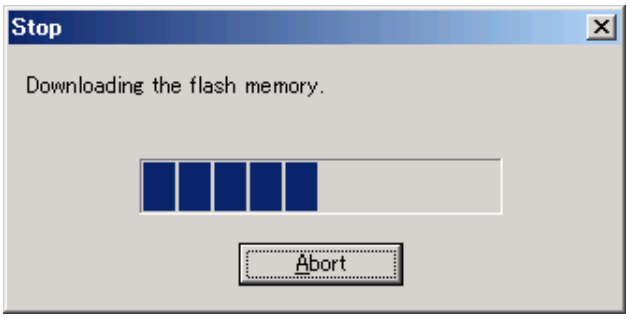
Writing to FLASH memory/code break (software break) functions are supported. The content of FLASH memory is secured in the buffer within the debugger, and the content of the buffer is referenced at reading/writing.

Writing FLASH memory is carried out automatically in the following cases.

- Before program execution processing
- Before reset processing
- Before end of debugging

When necessary, it can be carried out manually instead of via the above-mentioned processing.

The following dialog is displayed at writing to FLASH memory.



There are the following three functions for the operation of FLASH memory:

1. Updating FLASH memory

   ([Environment] - [FLASH area control] - [Download FLASH memory] menu).

   Updates Flash memory. Normally, Flash memory is updated automatically before performing execution or reset processing and before stopping the debugger. Use this menu when updating Flash memory before this automatic updating.

   This menu is enabled when data in the FLASH memory is changed, requiring the writing to FLASH memory.

2. Synchronizing FLASH memory

   ([Environment] - [FLASH area control] - [Synchronize FLASH memory] menu).

   Reads the contents of FLASH memory, and synchronizes with a buffer in the debugger. Be sure to perform this synchronization when FLASH memory is rewritten by the user program, or the content of the memory may not be referenced properly.

   Furthermore, synchronization is made automatically before starting the debugger.

3. Erasing FLASH memory

   ([Environment] - [FLASH area control] - [Erase FLASH memory] menu).

   Erases all data in FLASH memory. Note that this operation will also erase all code break (software break) settings.

Note:

Chip erasing is automatically executed for 1-sector device.

2.4.3 Erasing/Programming FRAM Area

This debugger supports erasing/programming FRAM area.

■ Erasing/Programming FRAM

This debugger supports erasing/programming FRAM area.

Both erasing and programming can be performed in the same way as to the RAM area.

To erase the UseFRAM area completely, perform the following operations.

[Environment] - [Flash area control] - [Erase Flash memory] menu

Note:

- The following menus are disabled FRAM is used.
  - [Flash area control] - [Update Flash memory] menu
  - [Flash area control] - [Synchronize FLASH memory] menu

2.4.4 Notes on Executing Program

The following points must be noted when executing a program using this debugger.

■ Break at Standby Mode

When the abort operation is executed in the standby mode, the debugger cancels the standby mode and aborts the execution. Therefore, it is aborted in next address of instruction to be transmitted to the standby mode.

2.4.5 FLASH Security

This debugger performs a support for the FLASH security function installed in the MCU.

■ FLASH Security

This debugger performs a support for the FLASH security function installed in the MCU. The FLASH security function manipulates the value of the security byte (1-byte area in the FLASH memory defined for each MCU) to place the FLASH memory in protected state (in which no debug operation other than erasing the FLASH memory is accepted) so that programs and other content in the FLASH memory are undisclosed to third parties. There are the following two types of detection timing to detect the protected state using the FLASH security function.

At startup of debugging:	When the FLASH memory is already in the protected state.
During debugging:	When the memory moves to the protected state by an operation such as writing to the memory.

When it is determined that the FLASH memory is already in the protected state, the following dialog appears.

Softune896
The flash memory is protected.
To start debugging,
all contents in the flash memory need to be erased.
Are you sure you want to erase all contents in the flash memory?
Yes
No

If "Yes" is selected, the debugger starts or debugging continues once the FLASH memory is erased. If "No" is selected, the debugger stops.

■ FRAM Device

The FRAM memory security function is supported as well as the flash security.

2.4.6 Notes on Starting/Stopping Debugger

The following points must be noted when starting or stopping this debugger.

■ When Starting Debugger

As the FLASH memory uses a buffer-style control, it must always be synchronized with the FLASH memory first. At startup of the debugger, it is automatically synchronized with the FLASH memory. This may take a significant time because the entire FLASH memory of the MCU must be read. Under the following conditions, it takes approximately 20 seconds.

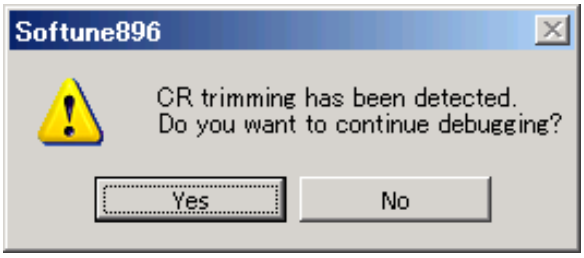
FLASH memory: the sector size = 16KB

Clock: Clock-up mode = ON

For this debugger, the power supply can be monitored. If an abnormality is detected at startup of the debugger, the following dialog will appear.

When "OK" is selected, the startup of the debugger is retried. When "Cancel" is selected, the debugger stops.

This debugger cannot be started, unless the clock is in the normal state. Therefore, if an abnormality is detected at startup of the debugger, the following dialog will appear.



When "Yes" is selected, the startup of the debugger is retried. When "No" is selected, the debugger stops.

■ Debug the End

The software break which is set in the FLASH memory during debugging must be erased before the debugging ends, considering that the MCU may be used standalone after the debugger stops. Therefore, the FLASH memory should be updated for each sector to which the software break is set. The time required depends on the setup conditions of the software break.

Note:

When a software break is set, standalone operation cannot be guaranteed under the following conditions.

- Operation is aborted while the FLASH memory is being updated upon completion of debugging
- Workbench ends abnormally during debugging
- Hardware connection is disconnected during debugging

2.4.7 Break

This Debugger provides two types of break functions. When by each break function aborts program execution, the address where a break occurred and the break factor are displayed.

■ Break Functions

This Debugger provides the following two types of break functions;

- Code break
- Forced break

2.4.7.1 Code Break

This function aborts the program execution by monitoring a specified address. A break occurs before executing an instruction at the specified address.

■ Code Break

This function aborts the program execution by monitoring a specified address by means of software or hardware. A break occurs before executing an instruction at the specified address.

The maximum points to be set are as follows.

Hardware: 3 points

Software: 256 points

When the code break occurs, the following message appears in the status bar.

- Hardware
  Break at address by hardware breakpoint
- Software
  Break at address by breakpoint

■ Setting Method

Code break can be controlled as follows.

- Command
  - SET BREAK
    Refer to "3.1 SET BREAK (type 1)" of "SOFTUNE Workbench Command Reference Manual".
- Dialog
  - Break point setting dialog [code] tab
    Refer to "4.6.4 Break Point" of "SOFTUNE Workbench Operation Manual".
- Window
  - Source window/disassemble window
    Refer to "3.7 Source Window" or "3.9 Disassemble Window" of "SOFTUNE Workbench Operation Manual".

2.4.7.2 Forced Break

This function forcibly aborts the program execution to generate a break.

■ Forced Break

This function forcibly aborts the program execution to generate a break.

When the forced break occurred, the following message appears at the status bar.

Break at address by command abort request

2.4.8 Confirming the Debugger's State

This section explains methods of confirming the debugger's state and its information.

■ Debugger Information

With this emulator debugger, the following information can be obtained at the time of startup.

- File information of SOFTUNE Workbench
- Hardware-related information

If problems are encountered with SOFTUNE Workbench and its behavior, refer to the information before contacting the Sales Representatives.

■ Confirmation Method

Debugger's information can be confirmed as follows.

- Command
  - SHOW SYSTEM
    Refer to section "1.12 SHOW SYSTEM" of "SOFTUNE Workbench Command Reference Manual".
- Dialog
  - Version information dialog
    Refer to section "4.9.3 Version Information" of "SOFTUNE Workbench Operation Manual".

■ Content to be Displayed

```
F2MC-8L/8FX Family SOFTUNE Workbench VxxLxx
ALL RIGHTS RESERVED,
  COPYRIGHT(C) FUJITSU SEMICONDUCTOR LIMITED 1997
LICENCED MATERIAL -
  PROGRAM PROPERTY OF FUJITSU SEMICONDUCTOR LIMITED
=====================================================
Cpu information file path    : Path to the CPU information file
Cpu information file version : Version of the CPU information file
=====================================================
Add in DLLs
-----------------------------------------------------
 SiCmn
 Product name        : SOFTUNE Workbench
 File Path           : Path to SiC896.dll
 Version             : Version of SiC896.dll
- - - - - - - - - - - - - - - - - - - - - - - - - - -
 SiiEd
 File Path           : Path to SiiEd3.ocx
 Version             : Version of SiiEd3.ocx
-----------------------------------------------------
 SiM896
 Product name        : SOFTUNE Workbench
 File Path           : Path to SiM896.dll
 Version             : Version of SiM896.dll
- - - - - - - - - - - - - - - - - - - - - - - - - - -
Language Tools
 - Compiler
   File Path         : Path to fcc896s.exe
 - Assembler
   File Path         : Path to fasm896s.exe
```

```
 - Linker
   File Path         : Path to flnk896s.exe
 - Librarian
   File Path         : Path to flib896s.exe
 - FJ-OMF to S-FORMAT Converter
   File Path         : Path to f2ms.exe
 - FJ-OMF to INTEL-HEX Converter
   File Path         : Path to f2is.exe
 - FJ-OMF to INTEL-EXT-HEX Converter
   File Path         : Path to f2es.exe
 - FJ-OMF to HEX Converter
   File Path         : Path to f2hs.exe
-------------------------------------------------------
 SiOsM
 Product name        : SOFTUNE Workbench
 File Path           : Path to SiOsM896.dll
 Version             : Version of SiOsM896.dll
-------------------------------------------------------
 F2MC-8L/8FX Series Debugger DLL
 Product name        : SOFTUNE Workbench
 File Path           : Path to SiD896.dll
 Version             : Version of SiD896.dll
- - - - - - - - - - - - - - - - - - - - - - - - - - - - -
Debugger type        : Current debugger type
MCU type             : Currently selected target MCU
VCpu dll name        : Path and name of currently selected virtual debugger section DLL
VCpu dll version     : Version of currently selected virtual debugger section DLL
Adapter type         : BGM adapter currently used
Adapter version      : Version of the adapter
Target type          : BGM target currently used
Target version       : BGM target version
Communication device : Device type
-------------------------------------------------------
 SiIODef
 Product name        : SOFTUNE Workbench
 File Path           : Path to SiIODef.dll
 Version             : Version of SiIODef.dll
=======================================================
Current path         : Currently specified project path
Language             : Currently selected language
Help file path       : Path to the help files
```

2.5 Emulator Debugger (MB2146-07)

This section explains the functions of the emulator debugger (MB2146-08) for the F^{2}MC-8FX Family.

■ Emulator Debugger

The emulator debugger (MB2146-07) for F^{2}MC-8FX family is a software product that controls the emulator from the host computer to evaluate programs.

■ Before Use

When using the emulator debugger (MB2146-07), set up the USB interface. For details, refer to "Appendix D Setting USB Interface" of "SOFTUNE Workbench Operation Manual".

Notes:

- If the connected MCU is not compatible with the BGM adapter (MB2146-07), the debugger cannot be started. For information of compatibility, refer to the Hardware Manual for the product type you are using.
- When using MCU of Target Version "3.x" with the emulator debugger (MB2146-07), step execution for the codes which change the following register values always results in the same value.

  ```
  PLLC = 0x90;
  SYCC = 0xFE;
  ```

  To check Target Version, refer to "2.5.9 Confirming the Debugger's State".

2.5.1 Setting Operating Environment

This section explains the operating environment setup.

■ Setting Operating Environment

When using this debugger, set up the operating environment for the following items. When using the default settings, this step can be omitted because each item is set to the default at startup. Furthermore, the setting value is restored during the next debugger startup.

- Optimization of Response Speed
- Oscillation Frequency
- Power Supply to the BGM Adapter
- Synchronization of FLASH memory at startup of debugger
- Automatic Update of Firmware

2.5.1.1 Optimization of Response Speed

This section describes the optimization of response speed.

■ Optimization of Response Speed

The communication speed between the BGM adapter (MB2146-07) and user system varies depending on the operating frequency of the target MCU. This emulator debugger provides a function that automatically raises the operating frequency to optimize the communication speed. This function is called the optimization of response speed.

If the optimization of response speed is disabled while the operating frequency is low, the screen update may be delayed because of increase of data reading time for debugger.

■ Setting Method

To enable/disable the response speed optimization function, use one of the following.

The default is enabled.

- Setup wizard

  Refer to section "4.7.2.5 Setup Wizard" of "SOFTUNE Workbench Operation Manual" for detailed information.

- [Response Speed] tab on debug environment setting dialog

  Refer to section "4.7.2.3 Debug Environment" of "SOFTUNE Workbench Operation Manual" for detailed information.

This setting is also used to temporarily stop a user program in the RAM monitoring function.

Note:

When the response speed optimization function is enabled, the operating frequency is automatically changed at break of user program. If you do not want to change the operating frequency automatically, disable the response speed optimization function.

2.5.1.2 Oscillation Frequency

This debugger requires an oscillation frequency setting.

■ Setting Oscillation Frequency

The communication speed between the BGM adapter (MB2146-07) and user system varies depending on the operating frequency of the target MCU. To obtain the operating speed of the target MCU, set the oscillation clock (F_{CH}) of the main clock. The default is set to the maximum frequency with which the specified MCU operates with the main clock. Please refer to the hardware manual of the kind used for details of the oscillation clock (FCH) of the main clock.

■ Setting Method

The oscillation frequency is set by setup wizard.

For detailed, refer to section "4.7.2.4 Setup Wizard" of "SOFTUNE Workbench Operation Manual".

Note:

If only the built-in main CR clock is enabled, use the default.

For details of the built-in main CR clock, refer to the Hardware Manual for the product type you are using.

2.5.1.3 Power Supply to BGM Adapter

This debugger requires a setting for power supply to the BGM adapter.

■ Power Supply Setting

The emulator debugger (MB2146-07) can directly supply power to the target.

■ Setting Method

Power supply to the BGM adapter is set as follows.

The default is disabled.

- Setup Wizard

For detailed, refer to section "4.7.2.4 Setup Wizard" of "SOFTUNE Workbench Operation Manual".

Note:

- Even if "Supply power from the BGM adapter to the target" of setup wizard is enabled, the target does not operate in any of the following cases. Refer to the specifications of the target board or the hardware manual of the BGM adapter (MB2146-07) for detailed information.
  - A power wire from the BGM adapter (MB2146-07) is not connected to the target.
  - The voltage supplied with the BGM adapter (MB2146-07) to the target does not reach the value level required to drive the target.

2.5.1.4 Synchronization of FLASH memory at Startup of Debugger

This debugger requires a setting to specify whether or not to synchronize FLASH memory when the debugger starts.

■ FLASH Memory Synchronization Setting

The BGM adapter (MB2146-07) secures the content of FLASH memory in the buffer within the debugger, and the content of the buffer is referenced at reading/writing. Specify whether or not to synchronize the contents of that buffer with the latest data of FLASH memory when the debugger starts. For details about synchronizing FLASH memory, refer to section "2.5.2 Erasing or Writing FLASH Memory".

■ Setting Method

FLASH Memory Synchronization is set as follows.

The default is enabled.

- Setup Wizard

For detailed, refer to section "4.7.2.4 Setup Wizard" of "SOFTUNE Workbench Operation Manual".

2.5.1.5 For this setting, use the setup wizard.

This debugger requires a setting to specify whether or not to automatically update firmware when the debug starts

■ Automatic Update of Firmware

The BGM adapter (MB2146-07) automatically updates the latest firmware based on information in the emulator when the debugging starts.

Firmware products compared for update are under Lib\907 of the SOFTUNE installation directory.

■ Setting Method

Automatic Update of Firmware is set as follows.

The default is enabled.

- Setup Wizard

For detailed, refer to section "4.7.2.4 Setup Wizard" of "SOFTUNE Workbench Operation Manual".

2.5.2 Writing to or Erasing FLASH Memory

This debugger supports writing to or erasing FLASH memory.

■ Writing to or Erasing Flash Memory

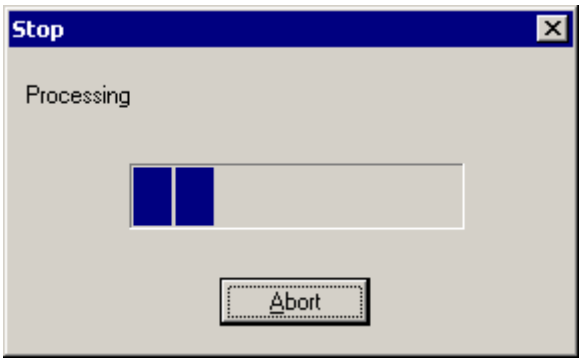
The emulator debugger (MB2146-07) supports writing to FLASH memory and making a code break (software break).

This debugger secures the content of FLASH memory in the buffer within the debugger, and the content of the buffer is referenced at reading/writing. For details of the code break (software break), refer to "2.5.7.1 Code Break".

Writing FLASH memory is carried out automatically in the following cases.

- Before program execution processing
- Before reset processing
- Before end of debugging

The following dialog is displayed at the time of writing to FLASH memory.



Perform one of the followings to manually write/erase FLASH memory.

- Updating FLASH memory

  ([Environment] - [FLASH area control] - [Download FLASH memory] menu)

  Updates FLASH memory. FLASH memory is usually updated automatically prior to executive operation or reset processing. Use this menu when updating FLASH memory before carrying out this automatic updating process.

  This menu is enabled when data in FLASH memory is changed, writing to FLASH memory is required.

- Synchronizing FLASH memory

  ([Environment] - [FLASH area control] - [Synchronize FLASH memory] menu)

  Synchronizes the content of the buffer in debugger with that in the flash memory.

  Synchronization is automatically performed in steps shown below.

  1. The debugger reads the content in the flash memory.
  2. The content is compared to that of the buffer in debugger.
  3. If there is any difference, the content of buffer is overwritten with that in the flash memory.

  Be sure to perform this synchronization when flash memory is written by the user program.

  If the synchronization of flash memory is not performed, the following problems may occur.

  - The memory content of the debugger cannot be referred properly.
  - The user program cannot be executed properly.

- Erasing FLASH memory

  ([Environment] - [FLASH area control] - [Erase FLASH memory] menu)

  Erases all data in FLASH memory. Note that this operation will erase all code break (software break) settings.

Note:

When setting code break (software), the contents of the flash memory of the specified address are temporarily rewritten.

2.5.3 Writing to or Erasing FRAM Area

This debugger supports writing to or Erasing the FRAM area.

■ Writing to or Erasing FRAM

This debugger supports writing to or erasing a FRAM product.

This area can be written to or erased in the memory window, in the same way as for a normal RAM area.

To erase all the FRAM area, select the following menu.

[Environment] - [FLASH area control] - [Erase FLASH memory] menu

Note:

- When an FRAM product is used, FRAM area update or synchronization is not performed even if any of the following menus is selected.
  - [FLASH area control] - [Download FLASH memory] menu
  - [FLASH area control] - [Synchronize FLASH memory] menu

2.5.4 Precautions on Program Execution

In this debugger, note the following points when executing a program.

■ Break in Standby Mode

If abort operation is performed in the standby mode, the debugger releases the standby mode, and aborts program execution. Therefore, abort at the address following the instruction that changes to the standby mode.

2.5.5 Flash Security Detection Function

This debugger supports the flash security function installed in the MCU.

■ Flash Security

This debugger supports the flash security function installed in the MCU.

The flash security function places programs in FLASH memory into the protected state, keeping the contents private for third parties. FLASH memory is placed into the protected state (*2) state by writing the specific value to the security byte (*1) in MCU. The protect state can be canceled by erasing all contents in the flash memory.

(*1) Security byte: 1 byte area within FLASH memory, specified for each MCU.

(*2) Protected state: Debug operations other than erasing FLASH memory are not accepted.

The flash security function detects the protected state at the following two times.

- At startup of debugger: Flash memory is already placed in the protected state.
- During debugging: Flash memory changes to the protected state due to memory writing.

If FLASH memory is in the protected state, the following dialog appears.

Softune896
The flash memory is protected.
To start debugging,
all contents in the flash memory need to be erased.
Are you sure you want to erase all contents in the flash memory?

If "Yes" is selected, FLASH memory is erased. The debugger is started if debugging is running.

If "No" is selected, the debugger is stopped.

■ For FRAM product

The FRAM memory security function is supported in the same way as for flash security.

2.5.6 Precautions on Starting and Ending the Debugger

In this debugger, note the following points when starting and ending the debugger.

■ When Starting the Debugger

- Synchronizing FLASH Memory

  Flash memory is controlled in the buffer method; therefore, the debugger must synchronize with FLASH memory at startup.

  - Synchronize: Reads all the contents of FLASH memory.
  - Not synchronize: Erases the contents of FLASH memory.

  For this setting, use the setup wizard. Refer to section "4.7.2.5 Setup Wizard" of "SOFTUNE Workbench Operation Manual" for detailed information.

  It takes up to 20 seconds longer for the debugger to start under the following conditions when "synchronization" takes place compared to the time when "synchronization" does not take place.

  Flash memory: The sector size is 16 KB.

  Clock: The clock-up mode is enabled.

- Power Monitoring

  This debugger supports power monitoring. If an error is detected at startup of the debugger, the following dialog appears.

If "OK" is selected, the startup of the debugger is retried. If "Cancel" is selected, the debugger is stopped.

- Detecting CR trimming

This debugger cannot be started unless the clock status is normal. If an error is detected at startup of the debugger, the following dialog appears.

If "Yes" is selected, the startup of the debugger is retried. If "No" is selected, the debugger is stopped. For details of CR trimming, refer to the Hardware Manual for the product type you are using.

■ When Ending the Debug

Considering that the MCU is to be used in the stand-alone mode after the debugging ended, this debugger automatically erases software breaks specified in FLASH memory when the debugging process ends. Therefore, update FLASH memory for each sector in which a software break is specified. The required time depends on the software break setting.

Note:

If a software break is specified, stand-alone operations cannot be ensured under the following conditions.

1. Updating FLASH memory was aborted when the debugger ended.
2. Workbench has been ended abnormally during debugging.
3. A connection with hardware has been disconnected during debugging.

2.5.7 Break

This debugger supports two types of break functions. If program execution is aborted by each break function, break address and break cause are displayed on the screen.

■ Break Functions

This debugger supports the following two types of break functions.

- Code break
- Forced break

2.5.7.1 Code Break

This function aborts program execution by monitoring a specified address. A break occurs before executing an instruction at the specified address.

■ Code Break

This function aborts a program by monitoring a specified address using hardware or software. A break occurs before executing an instruction at the specified address.

The maximum number of setting points are as follows.

Hardware: 3 points

Software: 256 points

When the code break occurs, the following message appears in the status bar.

- Hardware
  Break at address by hardware breakpoint
- Software
  Break at address by breakpoint

■ Setting Method

Code break can be set as follows.

- Command
  - SET BREAK
    Refer to "3.1 SET BREAK (type 1)" of "SOFTUNE Workbench Command Reference Manual".
- Dialog
  - Break point setting dialog [code] tab
    Refer to "4.6.4 Break Point" of "SOFTUNE Workbench Operation Manual".
- Window
  - Source window/disassemble window
    Refer to "3.7 Source Window" or "3.9 Disassemble Window" of "SOFTUNE Workbench Operation Manual".

2.5.7.2 Forced Break

This function forcibly aborts program execution.

■ Forced Break

This function forcibly aborts program execution.

When program is stopped by a forced break, the following message appears on the status bar.

Break at address by command abort request

■ Setting Method

A forced break is controlled as follows.

- Command
  - ABORT
    Refer to section "2.4 ABORT" of "SOFTUNE Workbench Command Reference Manual.
- Menu
  - [Debug] - [Stop] menu
    Refer to "4.6.2 ABORT" of "SOFTUNE Workbench Operation Manual".

2.5.8 RAM Monitoring

RAM Monitoring function monitors memory contents at a specific address while executing a user program.

■ RAM Monitoring

This function monitors memory contents at a specific address while executing a user program.

The monitoring function reads for each sampling cycle (refer to Figure 2.5-1); therefore, a user program stops at periodical intervals.

Up to 16 addresses can be specified on a 16-bit basis.

The specified addresses can be monitored on the RAM monitoring window.

■ Use Conditions

RAM monitoring is available when the following conditions are satisfied.

SOFTUNE Workbench: V30L33 or later

BGM adapter (MB2146-07):MB2146-07

■ Setting Method

RAM monitoring is controlled as follows.

- Command
  - SET RAMMONITOR
    Refer to section "4.29 SET RAM MONITOR" of "SOFTUNE Workbench Command Reference Manual".
- Dialog
  - RAM Monitoring Setup Dialog
    Refer to "4.4.15 RAM Monitoring" of "SOFTUNE Workbench Operation Manual".

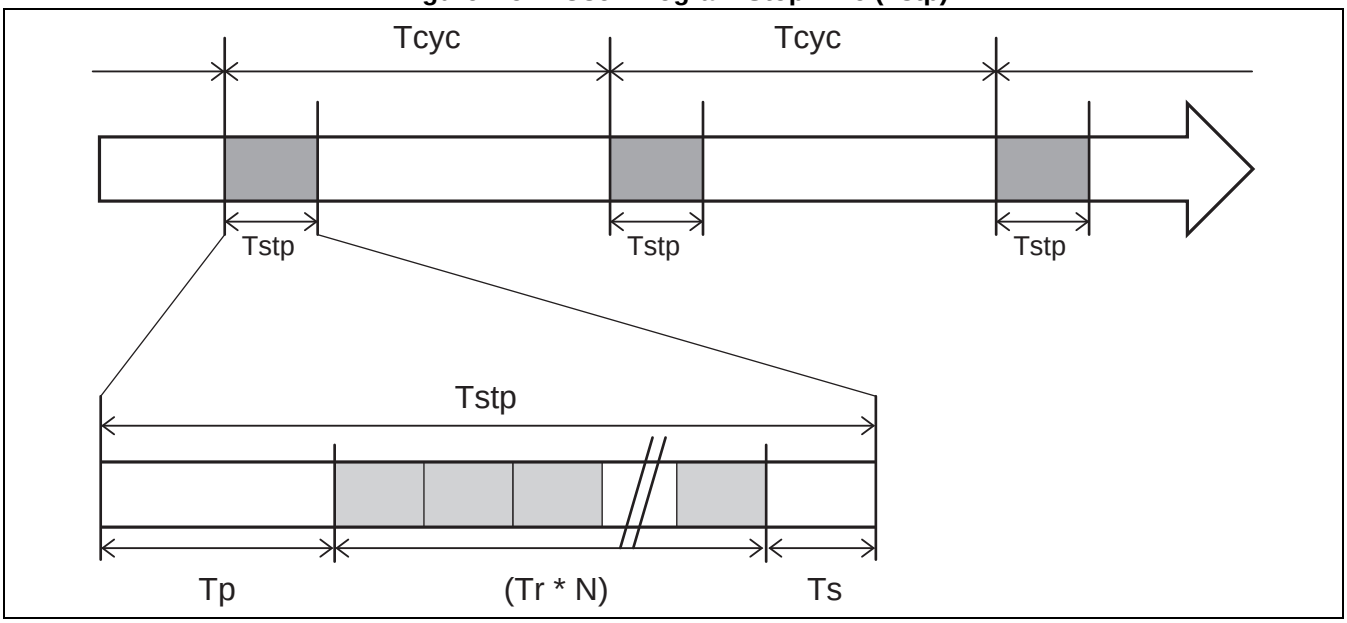
■ Stop Time during Monitoring

The RAM monitoring function temporarily stops executing a user program when reading, and restarts it after reading.

The stop time at reading varies depending on the following values.

- Operating frequency of user program
- Number of specified addresses

Figure 2.5-1 User Program StopTime (Tstp)



The stop time at reading can be obtained in the following formula.

User program stop time (Tstp) = Program stop processing time (Tp)
+ (1-address reading time (Tr) * Number of addresses (N))
+ Program restart processing time (Ts)

Sampling cycle (Tcyc): Default: 1 sec., Allowable range: 100 to 65535 ms

Table 2.5-1 Approximate time the user program stops

CPU product (Target Version)	Operating frequency	Stop time		Remarks
		Minimum (N=1)	Maximum (N=16)	
MB95F636 (From 3.1)	8 MHz	Approx. 55 ms	Approx. 60 ms	
	1 MHz (*)	Approx. 55 ms	Approx. 60 ms	* When the optimization of response speed is disabled
MB95F564 (2.x)	8 MHz	Approx. 58 ms	Approx. 65 ms	
	1 MHz (*)	Approx. 76 ms	Approx. 83 ms	* When the optimization of response speed is disabled
MB95F264 (1.x)	8 MHz	Approx. 78 ms	Approx. 105 ms	
	1 MHz (*)	Approx. 84 ms	Approx. 120 ms	* When the optimization of response speed is disabled

For details of the optimization of response speed, refer to "2.5.1.1 Optimization of Response Speed".

To check Target Version, refer to "2.5.9 Confirming the Debugger's State".

Notes:

- This function reads memory while temporarily stopping the execution of a user program. If a number of addresses are registered, it requires a longer program execution stop time.
- When a user program operates in the sub clock mode, it stops for a long time (1 sec. or more). Do not use the RAM monitoring function to avoid influence caused by stopping user program for a long time while running performance measurement, etc.
- The sampling cycle can be changed; however, if it is shorter than the stop time, a user program remains stopped. Specify the appropriate sampling cycle.

2.5.9 Confirming the Debugger's State

This section explains how to confirm debugger information.

■ Confirming the Debugger's State

This emulator debugger allows you to confirm the following information at startup.

- File information of SOFTUNE Workbench
- Hardware information

"If problems are encountered with SOFTUNE Workbench and its behavior, this file information can be referred when contacting the Sales/Support Division."

■ Confirmation Method

Use the following methods to confirm debugger information.

- Command
  - SHOW SYSTEM
    Refer to section "1.12 SHOW SYSTEM" of "SOFTUNE Workbench Command Reference Manual".
- Dialog
  - Version information dialog
    Refer to section "4.9.3 Version Information" of "SOFTUNE Workbench Operation Manual".

■ Content to be Displayed

The debugger information is displayed as shown below.

```
F2MC-8L/8FX Family SOFTUNE Workbench VxxLxx
ALL RIGHTS RESERVED,
  COPYRIGHT(C) FUJITSU SEMICONDUCTOR LIMITED 1997
LICENCED MATERIAL -
  PROGRAM PROPERTY OF FUJITSU SEMICONDUCTOR LIMITED
=======================================================
Cpu information file path    :Path to the CPU information file
Cpu information file version :Version of the CPU information file
=======================================================
Add in DLLs
-------------------------------------------------------
 SiCmn
 Product name : SOFTUNE Workbench
File Path    : Path to SiC896.dll
 Version      : Version of SiC896.dll
- - - - - - - - - - - - - - - - - - - - - - - - - - - -
 SiiEd
File Path    : Path to SiiEd3.ocx
 Version      : Version of SiiEd3.ocx
-------------------------------------------------------
 SiM896
 Product name : SOFTUNE Workbench
File Path    : Path to SiM896.dll
 Version      : Version of SiM896.dll
- - - - - - - - - - - - - - - - - - - - - - - - - - - -
Language Tools
 - Compiler
   File Path  : Path to fcc896s.exe
 - Assembler
```

```
   File Path  : Path to fasm896s.exe
 - Linker
   File Path  : Path to flnk896s.exe
 - Librarian
   File Path  : Path to flib896s.exe
 - FJ-OMF to S-FORMAT Converter
   File Path  : Path to f2ms.exe
 - FJ-OMF to INTEL-HEX Converter
   File Path  : Path to f2is.exe
 - FJ-OMF to INTEL-EXT-HEX Converter
   File Path  : Path to f2es.exe
 - FJ-OMF to HEX Converter
   File Path  : Path to f2hs.exe
-------------------------------------------------------
 SiOsM
 Product name : Softune Workbench
File Path     : Path to SiOsM896.dll
 Version      : Version of SiOsM896.dll
-------------------------------------------------------
 F2MC-8L/8FX Series Debugger DLL
 Product name : SOFTUNE Workbench
File Path    : Path to SiD896.dll
 Version      : Version of SiD896.dll
- - - - - - - - - - - - - - - - - - - - - - - - - - - - -
Debugger type        : Current debugger type
MCU type             : Currently selected target MCU
VCpu dll name        : Path and name of currently selected virtual debugger section DLL
VCpu dll version     : Version of currently selected virtual debugger section DLL
Adapter type         : BGM adapter currently used
Adapter version      : Version of the BGM adapter
Target type          : BGM target currently used
Target version       : BGM target version
Communication device : Device type
-------------------------------------------------------
 SiIODef
 Product name : Softune Workbench
File Path     : Path to SiIODef.dll
 Version      : Version of SiIODef.dll
=======================================================
Current path   : Currently specified project path
Language       : Currently selected language
Help file path : Path to the help files
```

2.6 Monitor Debugger

This section describes the functions of the monitor debugger for the F^{2}MC-8FX family.

■ Monitor Debugger

The monitor debugger works by incorporating a monitor program into the target system which provides debugging functions via communication with a host computer.

Before it can be used, the monitor program must be ported to the target hardware. Refer to the "Appendix E Incorporating the Monitor Debugger" of "SOFTUNE Workbench Operation Manual" for details.

Note:

The BGM adapter (MB2146-09A or later) is required to use the monitor debugger. The monitor debugger cannot be used with the old BGM adapter (MB2146-09). Attempting to use the old BGM adapter (MB2146-09) as a monitor debugger may cause a system fault.

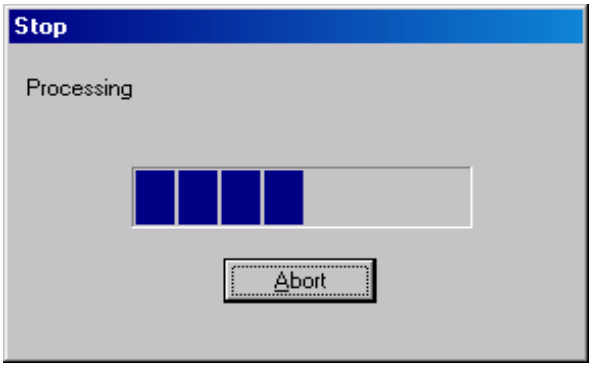
2.6.1 Writing to the FLASH memory

The monitor debugger supports writing to the FLASH memory.

■ Writing to the FLASH memory

The monitor debugger writes to the FLASH memory. Writing is only performed when loading the file.

The following dialog is displayed while writing to the FLASH memory.



■ Error Message if Loading Fails

The following error messages may be displayed depending on the content of the file being loaded to the FLASH memory. Refer to "Appendix B Debugger Related Error Messages" in the "SOFTUNE Workbench Command Reference".

1. If access to the FLASH memory occurs other than for loading:
   "The FLASH area can only be accessed by the LOAD command."
2. If a file that includes ROM or RAM areas is loaded:
   "Loading of files that include ROM or RAM areas is not permitted."

Notes:

- The FLASH memory is only written to when loading a file. The FLASH memory cannot be modified directly using the memory window or other memory manipulation commands.
- Only load files for the FLASH memory range to the FLASH memory. If a file contains data for other areas, it will not be written to the FLASH memory.
- Chip erasing is automatically executed for 1-sector device.

2.6.2 Fast downloading

Monitor debugger can shorten the download time to FLASH memory.

■ Fast downloading

When loading programs to FLASH memory, load time can be shorten to 1/6.

However, the Workbench automatically performs the following operations.

- Complete erasing of flash memory
- Resetting target files
- Rewriting RAM area

■ Conditions for Use

Fast downloading can be used under the following conditions.

SOFTUNE Workbench:	Version V30L32 or later
BGM adapter:	Model MB2146-09B-E

■ Setting Method

Set fast downloading as follows.

- Command
  - LOAD
    Refer to Section "7.1 LOAD" of "SOFTUNE Workbench Command Reference Manual".
- Dialog
  - [Load] tab of setup debug environment dialog
    Refer to Section "4.7.2.3 Debug Environment" of "SOFTUNE Workbench Operation Manual".

2.6.3 Points to Note when Executing Programs

Take note of the following points when using this emulator to execute a program.

■ Code Break Settings when Using Step Execution

The wild register is used temporarily when using the monitor debugger in step-in mode at the machine language level. As it is not possible to set code breakpoints during this time, code breakpoints are disabled.

In particular, when using step execution with the "interrupt mask" set to disable interrupts, you need to take note of this point in situations such as when a breakpoint is set in an interrupt handler. As breakpoints set in interrupt handlers are disabled, execution will not break even if the breakpoint code is executed.

2.6.4 Break

This Debugger provides two types of break functions. When by each break function aborts program execution, the address where a break occurred and the break factor are displayed.

■ Break Functions

This Debugger provides the following two types of break functions;

- Code break
- Forced break

2.6.4.1 Code Break

This function aborts the program execution by monitoring a specified address by software. A break occurs before executing an instruction at the specified address.

■ Code Break

This function aborts the program execution by monitoring a specified address by software. A break occurs before executing an instruction at the specified address.

Up to 2 addresses can be set for this debugger.

When the code break occurs, the following message appears at the status bar.

Break at address by breakpoint

■ Setting Method

Set code break as follows.

- Command
  - SET BREAK
    Refer to "3.1 SET BREAK (type 1)" of "SOFTUNE Workbench Command Reference Manual".
- Dialog
  - "Code" tab in breakpoint setting dialog
    Refer to "4.6.4 Breakpoint" of "SOFTUNE Workbench Operation Manual".
- Window
  - Source window/disassemble window
    Refer to "3.7 Source Window" or "3.9 Disassemble Window" of "SOFTUNE Workbench Operation Manual".

2.6.4.2 Forced Break

This function forcibly aborts the program execution to generate a break.

■ Forced Break

This function forcibly aborts the program execution to generate a break.

When the forced break occurred, the following message appears at the status bar.

Break at address by command abort request

2.6.5 Confirming the Debugger's State

This section explains methods of confirming the debugger's state and its information.

■ Debugger Information

With this monitor debugger, the following information can be obtained at the time of startup.

- File information of SOFTUNE Workbench
- Hardware-related information

If problems are encountered with SOFTUNE Workbench and its behavior, refer to the information before contacting the Sales Representatives.

■ Confirmation Method

Debugger's information can be confirmed as follows.

- Command
  - SHOW SYSTEM
    Refer to section "1.12 SHOW SYSTEM" of "SOFTUNE Workbench Command Reference Manual".
- Dialog
  - Version information dialog
    Refer to section "4.9.3 Version Information" of "SOFTUNE Workbench Operation Manual".

■ Content to be Displayed

The debugger information is displayed as shown below.

```
F2MC-8L/8FX Family SOFTUNE Workbench VxxLxx
ALL RIGHTS RESERVED,
  COPYRIGHT(C) FUJITSU SEMICONDUCTOR LIMITED 1997
LICENCED MATERIAL -
  PROGRAM PROPERTY OF FUJITSU SEMICONDUCTOR LIMITED
=====================================================
Cpu information file path    : Path to the CPU information file
Cpu information file version : Version of the CPU information file
=====================================================
Add in DLLs
-----------------------------------------------------
 SiCmn
 Product name        : SOFTUNE Workbench
 File Path           : Path to SiC896.dll
 Version             : Version of SiC896.dll
- - - - - - - - - - - - - - - - - - - - - - - - - - -
 SiiEd
 File Path           : Path to SiiEd3.ocx
 Version             : Version of SiiEd3.ocx
-----------------------------------------------------
 SiM896
 Product name        : SOFTUNE Workbench
 File Path           : Path to SiM896.dll
 Version             : Version of SiM896.dll
- - - - - - - - - - - - - - - - - - - - - - - - - - -
Language Tools
 - Compiler
   File Path         : Path to fcc896s.exe
 - Assembler
```

```
   File Path         : Path to fasm896s.exe
 - Linker
   File Path         : Path to flnk896s.exe
 - Librarian
   File Path         : flib896s.exe
 - FJ-OMF to S-FORMAT Converter
   File Path         : Path to flib896s.exe
 - FJ-OMF to INTEL-HEX Converter
   File Path         : Path to f2is.exe
 - FJ-OMF to INTEL-EXT-HEX Converter
   File Path         : Path to f2es.exe
 - FJ-OMF to HEX Converter
   File Path         : Path to f2hs.exe
-------------------------------------------------------
 SiOsM
 Product name        : SOFTUNE Workbench
 File Path           : Path to SiOsM896.dll
 Version             : Version of SiOsM896.dll
-------------------------------------------------------
 F2MC-8L/8FX Series Debugger DLL
 Product name        : SOFTUNE Workbench
 File Path           : Path to SiD896.dll
 Version             : Version of SiD896.dll
- - - - - - - - - - - - - - - - - - - - - - - - - - - - -
Debugger type        : Current debugger type
MCU type             : Currently selected target MCU
VCpu dll name        : Path and name of currently selected virtual debugger section DLL
VCpu dll version     : Version of currently selected virtual debugger section DLL
Adapter type         : BGM adapter currently used
Adapter version      : Version of the BGM adapter
Target type          : BGM target currently used
Target version       : BGM target version
Clock mode           : Main clock / sub clock
Communication device : Device type
-------------------------------------------------------
 SiIODef
 Product name        : SOFTUNE Workbench
 File Path           : Path to SiIODef.dll
 Version             : Version of SiIODef.dll
=======================================================
Current path         : Currently specified project path
Language             : Currently selected language
Help file path       : Path to the help files
```

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